CIVIL ENGINEERING

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A Precise Level Party of the U. S. Lake Survey at Work Under the Lower Arch Bridge in the Niagara River Gorge

Volume 8 — American Society of Civil Engineers Founded 1852 — *Number 1*

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Among Our Writers

Robert Ridgway, Past-President and Honorary Member of the Society, has had a long and distinguished career in public service. As chief engineer of New York City's Transit Commission (1921–1924) and Board of Transportation (1924–1932) he was in charge of the design and construction of much of that city's extensive subway system. Since 1933 Mr. Ridgway has been engaged in a consulting capacity on many large construction projects both in this country and abroad.

Aymar Embury II received civil engineering and master of science degrees from Princeton University, but has practiced architecture ever since—a period of over 35 years. In addition to his private practice he has served as consultant to the Port of New York Authority, the New York City Department of Parks, and the Triborough Bridge Authority.

D. Grant Mickle received a master's degree in street-traffic research at Harvard University (1931). The greater part of his work has been with Jensen, Bowen and Farrell, consulting engineers, Ann Arbor, Mich., as manager of the firm's traffic and transport department. Since August 1937 he has also been assistant director and planning engineer for the Michigan Highway Planning Survey.

Jacob Feld graduated first from the College of the City of New York (1918) and later received M.A., C.E., and Ph.D. degrees from the University of Cincinnati. His studies on earth pressure and soils received considerable recognition. For the past 13 years he has been in private practice in New York City, engaged chiefly in subsurface design and construction problems.

William G. Rapp, after graduating from Massachusetts Institute of Technology in 1922, specialized in the erection of steel structures. He has had wide experience, both in fabricating shops and loading docks, and in the field as worker, resident engineer, and in charge of erection of many projects. Since 1926 he has been an engineer in the erection department of McClintic Marshall Corporation, now a subsidiary of the Bethlehem Steel Company.

Francis C. Frary received his bachelor's, master's, and doctor's degrees in chemistry at the University of Minnesota, where he taught chemistry for about 10 years. After an engagement as research chemist, he was placed in charge of chemical technology at Edgewood Arsenal for a year during the World War. Since that time he has been director of research for the Aluminum Company of America.

C. R. Pettis has been engaged in various duties as an officer of the U. S. Corps of Engineers since 1904. He has been particularly interested in hydraulics and hydrology. At present, he is in charge of the U. S. Lake Survey Office.

Richard Shelton Kirby since 1915 has been in charge of the teaching of engineering drawing at Yale University, from which he holds Ph.B. and C.E. degrees. His experience also includes teaching civil engineering at Gettysburg College and some municipal engineering practice. He is author of a book on engineering history, and co-author with Messrs. Stoeckel and May of *Sense and Safety on the Road*, published in 1936.

Volume 8 Number 1

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

The Engineer in Public Life

Observations of Progress Over a 50-Year Period

By ROBERT RIDGWAY

HONORARY MEMBER AND PAST-PRESIDENT, AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, NEW YORK, N.Y.

THE following address was delivered by a Past-President and Honorary Member of the Society on November 3, 1937, at a meeting of the Columbia University Student Chapter, held in celebration of the tenth anniversary of the founding of the Chapter. These thoughts may strike a responsive chord in older as well as younger engineers.

IT has been my privilege, during a long and active life, to have been connected with many large public projects in which my native city, New York, has been engaged. I frequently compare the conditions of today with those of my early life. In spite of the fact that we like to think of those as "the good old days" I realize that the tone of public service has improved greatly; that public opinion is more alert; and that public officials are now held more strictly to account for their deeds than formerly. The standards of the contracting organizations are much higher than they were 50 years ago. Work generally is better organized and performed, is done more honestly and efficiently and, with some exceptions of course, with a better realization on the part of the contractor of his obligations to the public and, I believe, with a higher respect for the engineer and his profession.

Some of my best friends are contractors. For efficiency, courage, high mindedness and good sportsmanship they compare favorably with the best men of the community, and are a great asset to the country. Association with them broadens one and gives him renewed faith in human nature and its ability to overcome obstacles. I have a wholesome respect for them.

Right Prevails in the End.—Over 50 years ago as a young man I was on the construction of the so-called "new Croton Aqueduct"—a very large project for those days and one which, unfortunately, fell under the blight of political influence, because the contractors thought that was the way to make their profits. The contractors for a while disregarded the orders of the engineers, and much scamp work was done in spite of protests. For a time the situation seemed quite hopeless, but through the persistence of the engineers the right finally prevailed and the wrong was rectified. The work was repaired at large cost to the contractors.

Notwithstanding all the discouragements, the lesson was a useful one. It taught that right will win in the long run; and that men of character who are competent, faithful, and honest will prevail. It was in teaching this lesson that those engineers rendered their greatest service to the public. They did not condone or wink at the improper work but fought it unselfishly against all opposition. The weak and pliant ones disappeared from view and were generally unheard of afterwards. Had it not been for the persistent faithfulness of the responsible engineers there would have been a different and sadder story to tell.

Probably such a situation could not arise at all today. The present-day contractor of reputation has a pride in his work and desires to leave a creditable job behind him—not merely to make a profit Furthermore, he employs engineers of his own to guide him, and it is always a duty and a pleasure to cooperate with them to get the work done. Another thing—he places a higher value on the lives and comfort of the workmen. On the one hand, far greater precaution is now being taken to avoid accidents which would kill or maim the men and, on the other, care to serve their general comfort.

Easy to Blame the Engineer.—The position of the engineer on public work is a responsible one. He is frequently called upon to make decisions not only where technical knowledge and skill are needed, but also where a broad grasp is essential and where fairness of mind is very desirable. Firmness of character and an honest mind are certainly requisites. Very often he has to defend his decisions against those who honestly oppose them or who purposely misunderstand the situation for reasons of their own. This is part of the game, and if he is the right sort of a man he trains himself to stand the criticisms that are bound to come and to keep his head when unjustly attacked. He must expect to hear careless talk implying universal dishonesty in public office.

Any one guilty of such knavery should be punished severely; but I would advise those who talk so flippantly to look into the situation in something more than a superficial way and find out for themselves what the real circumstances are. When an able and honest man, giving the best that is in him to the public good, is accused by innuendo of dishonest practices or is looked upon as a grafter the injustice of it all rankles in his mind and impairs his usefulness. Constructive criticism is good

and should be encouraged; unjust criticism does more to break down morale than all the work of the politicians which we decry.

It seems to be the practice of the public to load responsibility on its servants without giving them commensurate authority. If this were corrected, in my opinion, efficiency and economy would be advanced. A public official should be selected with extreme care and then given such authority as is necessary for him to function properly. Then he should be held to a strict accountability for what he does.

Fair Dealing with Public and with Contractors.~The public has the reputation of being a hard taskmaster and is frequently exacting—wanting the impossible and impatient when it cannot get it. Young men entering public life ought to realize this, and feel that it is their duty to be patient while giving their efforts to the work in hand, and not expect too much praise for work well done. They should be prepared to make known the reasons for their actions. So that these reasons may not be misinterpreted, it is quite necessary that a good and comprehensive record be kept—this not only for the engineer's own satisfaction but for the protection of his employers.

A contractor is frequently heard to say that he is entitled to fair treatment from the engineer. That is admitted, but he sometimes forgets that the engineer is just as much entitled to proper treatment from the contractor. Both are human, of course. A fair-minded engineer, who comprehends the broad side of questions at issue, commands the respect of the honest contractors even when his decisions are against them. While the contractors may not be satisfied, they feel that their side has been given honest consideration.

Sometimes a contractor finds it necessary to lure an engineer from the public service. It has been my observation that when this happens he seldom takes one who has been weak and pliant, but generally a fair-minded chap with a stiff backbone who has been just in enforcing the terms of contracts. Like all other executives he wants the man who will be as true to his new interests as he was to those of his former employer, the public.

A Growing Field.~Public works of all kinds are assuming ever-increasing importance in these days, whether we approve or not. Gradually more and more work is being taken from private hands and assumed by public agencies. Such a tendency will probably increase, and it would be well for young men who enter the engineering field to realize it. There are many who are planning to make a career of public service. Those who do should prepare for it and go into it with their eyes open.

In cities like New York, protected by Civil Service regulations, the tenure of office is fairly secure, and there are few changes, especially in those departments which have to do with the maintenance and operation of utilities. The engineering force varies more where the activities of departments depend on the construction of projects that sooner or later must be completed, at which time the forces are reduced.

Engineers in public employ cannot look forward to the large pecuniary rewards that go with some private jobs but there is great satisfaction in designing and building works for the public good even though the public's appreciation of their efforts is not always in evidence. I was in the service of the public nearly 50 years and have not regretted it.

In this long experience I have noticed as a general thing that those men who displayed interest in their work, had a grasp of it, and were industrious and loyal in performing their tasks, were the ones who advanced and came out on top in the long run.

Danger in Cloistered Attitude.~Many opportunities have been afforded me to watch engineers as they worked. Some were so absorbed in their own affairs that they hedged themselves in, did not encourage visits from others and showed little disposition to inspect the work that other engineers were doing in their vicinity. This seems to me to be a wrong attitude. Intercourse with others is always helpful, and if the other man is doing his work better than you are it is well for you to know it early. I was always glad to have others, including young men, visit my work because I derived benefit from their visits and I hope that they did too.

When you come to direct work, aim for perfection in your organization, but do not be discouraged if you do not attain it. Study your subordinates and try to develop what is good in them, and remember that defects in the character of others are always apparent and it requires no great discernment to discover them. The good usually needs more patience and study to bring out and develop, but it certainly pays to attempt to do so.

Public vs. Private Employ.~If I was asked whether to recommend that you take a position in Civil Service or one with a private organization I would have difficulty in answering. Both have their advantages and their drawbacks, and much depends on opportunities which neither the individual nor the public department can control. As a general thing, I think, the private employer may hold his men to a stricter sense of responsibility and perhaps exact more of them than do those who run a public department. But not always.

Then, too, the private executive, not being so much hampered by red tape, is freer to recognize good service and to advance deserving employees. Much also depeods on whether the private employer can command the continuance of work that permits him to retain and advance the members of his force.

Public work, on the other hand, is recognized as being more certain of tenure. If one is fortunate enough to get into a department which has prestige, has plenty of active work in hand, and is under the charge of a high-minded and competent engineer, he is happily placed; but he must not expect rapid promotion. Usually the young man—wisely, I think—takes the job offered and makes the most of it. Remember, it is always easier to find a new job when you already have one.

I can imagine no more miserable being than one who realizes that he is in the wrong field and finds no joy in his work. While we all desire an adequate return for our labor, so that we and our families may live in comfort, it is not alone the financial return that gives the most satisfaction. Life's greatest rewards come from the consciousness of work well done, and no one, it seems to me, can have a greater measure of such satisfaction than the engineer in public life who has served his fellow citizens faithfully and well.

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Number 1

The Architect and the Engineer

Reconciling Some Mutual Differences Between Two Closely Related Professions

By Aymar Embury II

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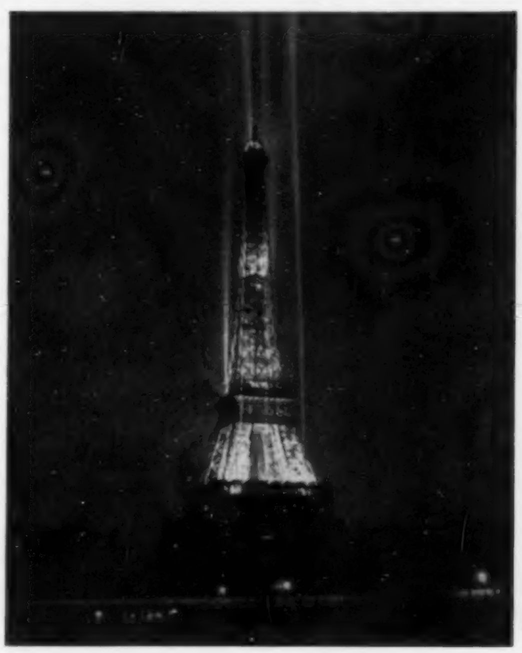
In engineering, as in any other branch of applied science, it is often helpful to get the other fellow's point of view. The "other fellow" in this case is the architect, whose profession may be classified as applied esthetics. Engineers and architects, says Mr. Embury, are fundamentally practicing the same art, and their partnership should begin at the very inception of every job, so that the structural and esthetic aspects of each particular design may be worked out together. Mr. Embury is particularly qualified to discuss this matter because of his training in both fields. The accompanying article, while complete in itself, also provides a fitting introduction to two interesting articles on the esthetics of bridge design, to appear in forthcoming issues. Acknowledgment is made by the author to O. H. Ammann, H. D. Robinson, D. B. Steinman, J. A. L. Waddell, Shortridge Hardesty, E. R. Needles, H. C. Tammen, Emil Praeger, Ralph Smillie, and (in particular) Allston Dana, all Members of the Society, to whom he feels himself obligated for suggestions and in some cases opinions and statements of fact incorporated in the text.

Let us be honest and admit that the architect and the engineer do not always hit it off very well. There exists between the two professions a sort of nebulous hostility which, if analyzed, is discovered to be a curious combination of not too heavily veiled contempt and a sort of grudging admiration. The architect is accustomed to stress the esthetic rather than the practical—that is to say, the appearance of things rather than their construction, and sometimes looks upon the engineer as a rough uncultured fellow who not only deliberately denies himself the happiness of esthetic appreciation, but is probably incapable of it anyway. The engineer, in turn, seems to think that the typical architect is a feeble sort of dilettante who does not know anything about structure, could not think clearly about it if he did, and therefore tries to cover up his lack of fundamental knowledge with a lot of mushy words about "beauty," "proportion," and so on. Probably some justification exists for such feelings on both sides. There are a good many half-baked architects, and (while in no engineering magazine would I dare make a definite assertion) it has sometimes appeared to me that there are engineers who really do not know their business any better than the architects, their potentialities being limited to a somewhat primitive ability for discovering a radius of gyration and for using a table of logarithms.



View of Eiffel Tower, Illuminated at Night

While the architect will rarely admit it, he is consumed with a sort of secret envy for the man who really knows why things stand up, or who (if he really doesn't know it, which is very likely the case) can at least make an approximately correct estimate of the minimum amount of material which it is necessary to put into a column to prevent it from bending, or—even more marvelous—knows how the material should be disposed about the axis of the column. The engineer likewise, contemptuous as he is of the architect's preoccupation with esthetics, does not feel that any really important engineering work is complete without an architect tacked on somewhere.

Now, this condition of affairs is not sensible, nor is it productive of good results. Engineering and architecture are fundamentally the same art and for many centuries the practitioners were indifferently called by either or both titles. When he built the dome of St. Paul's, Sir Christopher Wren tackled a strictly engineering problem; yet, in the light of knowledge of that time, he accomplished a pretty fine piece of engineering work. At

least the structure has stood up for three hundred years with little upkeep, and that is after all the test of good engineering (although one engineering collaborator has said that a good many engineers would prefer to have it fall down if it were "good" engineering rather than stand up if it were "bad"). Vauban, while primarily a military engineer, also enjoyed the title of "Architecte du Roi."

With men of that generation there was no cleavage between the structure and its adornment, and no petty jealousy between the engineer and the architect. Whether the two functions are combined in one person with knowledge of both architecture and engineering, or in a pair of men, or even in a large group working together, these two professions should be a unit, beginning at the very inception of the job. Structure and esthetics are inseparable. Structural designs cannot be completed and esthetics applied like a coat of paint—this would be like a hunchback with a beautiful skin, the form showing through.

The value of the architect in the association between engineer and architect on large-scale engineering works arises primarily from the fact that the whole of an architect's training leads him to consider from the very beginning what the structure is going to look like. The architect constantly studies the problem by means of sketches in perspective, while the engineer begins with diagrams and a table of weights. Of course, both engineer and architect rely far too much upon habit and precedent—the engineer thinking and often saying, "This is the way we did it in the case of the Smith River Bridge, which turned out very successfully," and the architect, "Now I remember the Roman Bridge at Albi...." Many times neither really takes the trouble to find out what he ought to do on this new bridge over the Robinson River.

Travel Association of Great Britain and Ireland

ST. PAUL'S CATHEDRAL ON LUDGATE HILL, LONDON

Masterpiece of Sir Christopher Wren, the Cathedral Was Originally Designed in the Form of a Greek Cross, But Was Modified to Include a Nave and Side Chapels

The engineer, looking at the problem from his own past experience, may say, "What you propose, Mr. Architect, is not good engineering," when all he means to say is that it is not an economical structure (although he is usually not even certain that it is not). When the architect says, "This is a lousy-looking design," all he means is that it is different from the design of the masonry structures on which he was brought up. There is no doubt but that habit of mind has an immense effect on esthetic appreciation. We cannot really judge a new piece of design correctly, for we have no standards of comparison, but on the other hand there is always a tendency to admire novelty regardless of its positive esthetic value.

Time is the only one true arbiter of beauty, and it may truly be said that no structure which does not embody fundamentally sound engineering will ever continue to be thought beautiful. The Eiffel Tower is perhaps a good example—here was the tallest steel structure which had ever been built, so daring in conception that it remained the tallest for nearly half a century, designed with a distinct effort to make it esthetically satisfactory. But the very features which were so treated, notably the spread legs of the lower portion, were not based on good engineering principles and are today the most generally condemned portion of the structure, from the esthetic as well as from the structural point of view.

It is my belief that more good engineering projects are spoiled by false deference to assumed esthetic considerations than by any economic requirements. No really clean, well-thought-out bridge, where the details have been carefully studied for good connections, proper bracing, and proper carrying of the loads, can be downright bad. It may not be exceedingly beautiful, but at least it will never be very ugly; whereas the structure whose function is partly concealed and partly distorted for supposed esthetic reasons, will inevitably be unsuccessful. It does not seem to matter whether this distortion is the result of bringing in an architect so late that he never does understand what he is trying to do, or whether the engineer himself, having completed his basic design, feels that it needs something to "doll" it up and does what he thinks an architect would do if he had an architect in his employ.

It is not necessary that the engineer designer should have as his associate an architect to produce a beautiful design, but he must have the architectural approach either in his own head or through an associate.

The required amounts of steel can be disposed in many ways, differing only slightly among one another, which may nevertheless profoundly affect the rhythm and pattern of the structure. For example, in a simple truss bridge it is common practice to decrease the members in length and width when they carry lesser loads, whereas the esthetic pattern would be improved if lighter members of the same dimensions were selected. This is design by handbook and not by brains, and while it may not be very bad, it probably won't be very good either.

There is another form of design by drawing instruments which is even more deadly. How often do engineers, because their triangles are 45, 30, and 60 deg, use one of these slopes for diagonal members? Nobody knows; but everybody knows that it occurs very often. The architect, alas, too often follows the easiest way in the same manner, but his habit of beginning his design with a free-hand sketch enables him to see the picture he has formed in his head, and may keep him from using a 30-deg angle simply because it is easy to draw. Likewise, while it is usual and generally better to lay off a truss in equal panels, yet there are occasions when a truss of unequal panels will be better. At any rate one should look.

In other words, engineers should be good architects, and architects good engineers!

Elements of Traffic Planning

Outlining the More Important Steps in the Formulation of an Effective Plan

By D. Grant Mickle

Associate Member American Society of Civil Engineers

Traffic Engineer, Jensen, Bowen and Farrell, Engineers, Ann Arbor, Mich.; Assistant Director, Highway Planning Survey, Michigan State Highway Department

Citizens of many American municipalities suffer tremendous annual losses in time of transit, accidental injuries, and depreciation of property values through traffic congestion resulting from the lack of, or the failure to adhere to, a proper city plan. Traffic planning in most cases is an attempt to mitigate such losses by coordinating and regulating the movements of pedestrians and vehicles. The more important steps in the formulation of a traffic plan, as outlined by Mr. Mickle in the case of Detroit, include a study of population trends and distribution, investigation of automobile origins and destinations, development of traffic-movement and traffic-density patterns, gathering of data on accumulations and movements in areas of concentrated destinations, and a survey of parking practices and locations and causes of accidents. The article is an abstract and development of the subject matter presented by Mr. Mickle in his address before the Institute of Traffic Engineers at the Greater New York Safety Conference, held in April 1937.

Traffic planning may be defined as programming the movements of persons, vehicles, and merchandise so that they shall be coordinated and made regular and safe through the application of sound principles of physical construction and regulation. Traffic planning is inseparably linked with city planning, which concerns itself primarily with the location and arrangement of the thoroughfare system, parks, and other recreational centers, and (through zoning) with a control over land use. Unfortunately, the need for sound planning is generally recognized too late, and today it is largely defensive in nature. While planning is the first essential, it alone is not sufficient; deviations should be minimized and not permitted to undermine the primary structure.

The hodgepodge of streets and the diversity of traffic characteristic of many American cities do not always bespeak the lack of a plan but often the lack of adherence to one. An example of this is the experience of the city of Detroit. Following the fire of 1805 in which the village of 6,000 persons was completely destroyed, a plan was adopted, patterned after that of the city of Washington and manifesting the influence of the planner, L'Enfant. It provided for thoroughfares 200 ft wide to follow the four directions of the compass, spaced at intervals of 4,000 ft in a north and south direction, and 2,000 ft in an east and west direction. At the intersections of the main avenues, circles 500 ft in diameter were established, and each quadrant formed by the diagonal secondary streets was further divided into avenues 60 and 120 ft wide, providing the necessary areas for local communication.

Only remnants of this plan remain and even these are difficult to identify. The abandonment of the plan and the discordant system of Detroit thoroughfares today are manifestations of the effect of exploitation on the part of land owners and subdividers, made possible through a lack of governmental control guided by an official plan. Traffic planning must now be the means of accomplishing what might have resulted if the city had been built in accordance with the plan of 1805.

Boston is probably the outstanding example of a great concentration of persons in a city where the lack of a plan resulted in the construction of streets along legendary cowpaths. Washington, on the other hand, was built in accordance with a plan, and its streets provide a high degree of utility, their width and arrangement making possible an esthetic development.

Although proper city planning simplifies to a certain extent the task of providing for traffic, the present complexity of traffic composition and movement creates a need for street appurtenances and regulation. As population density increases, the use of the private automobile as a means of individual transportation decreases, because the resulting condition of congestion discourages further use of the automobile, and population turns to other means such as are provided by bus, street car, or rapid transit.

A conservative estimate of the economic loss, due to congestion alone, in a community of a million and a half persons, has been placed at $10,000,000 annually. This estimate includes only the contribution made by operators of private automobiles. To the economic sacrifices which are made because of congestion must be added those attributable to accidents. It is difficult to assign a monetary value to the loss resulting from the human misery, tragic death, and property damage involved in 38,000 reported mishaps in which 372 persons were killed, as occurred in Detroit in 1935. Whatever these estimates might be, they would reach enormous proportions.

Furthermore, congestion has caused the most popular areas of concentration of destinations to become less and less accessible, creating further losses when decentralization brings about depreciated property values. Thus,

Michigan State Highway Department

Traffic Planning Can Accomplish a Balanced Distribution of Load and Avoid Much Costly Street Widening Such as This

when businesses are scattered, overhead is increased, and the need for the transportation of persons between points at greater distances not only spreads congestion but is responsible for an increase in the total passenger miles traveled. This additional cost must be added to that of congestion and accidents in order to arrive at a concept of the price we pay for our present composition of community travel.

Detroit has provided much of the highway income of the state, and in recent years the Michigan State Highway Department has assumed more and more financial responsibility for the improvement of traffic-ways within urban areas. To apply expenditures in accordance with the potentialities of various sections, it became necessary to determine the travel habits, points of concentration, and other factors influencing traffic within cities.

Murray D. Van Wagoner, State Highway Commissioner, recognized the necessity for obtaining basic traffic engineering facts in Detroit, and arranged to conduct as a part of the Michigan highway planning survey a comprehensive traffic survey in that city. The maps and charts described here are a partial result of the study conducted under his administration.

STUDY OF POPULATION DISTRIBUTION THE FIRST STEP

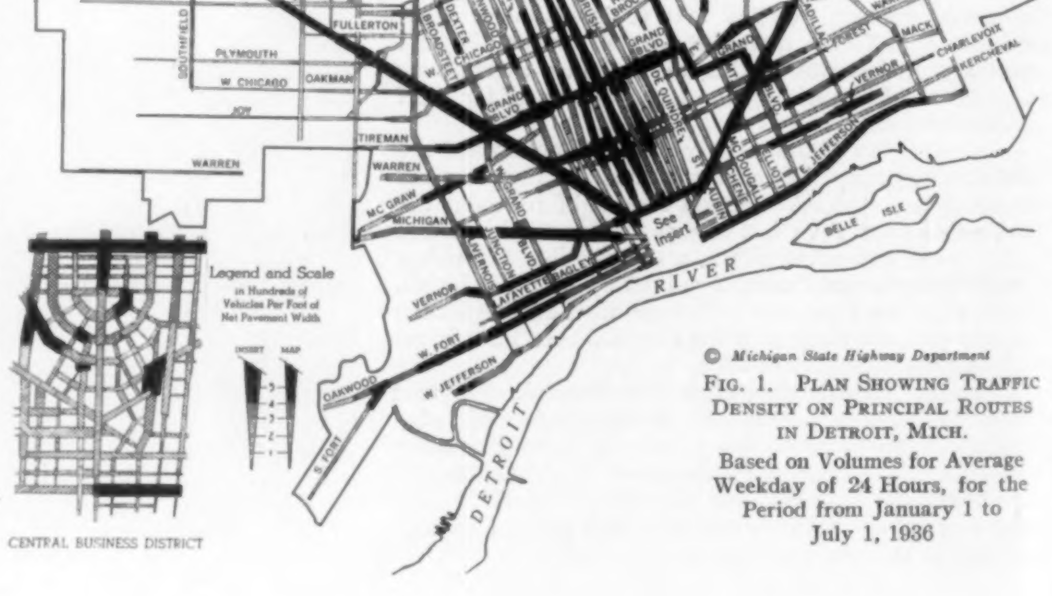
The first step in traffic planning is to determine the rate of population growth in the past and to anticipate it for the future. If investigations of the elements controlling growth of population point within a reasonable time to a community two or three times its present size, the traffic plan should anticipate the needs at the end of that time. These needs in a growing community should unquestionably include adequate surfaces for the movement of free-wheeled traffic; right of way for rail communication on, above, or below the surface; a space—preferably underground—for public utilities, including water, sewers, electricity, and telephone communication; adequate provision for the accessibility of emergency services, including police and fire protection, to all properties; and provision for sufficient light and air.

Next it becomes necessary to investigate the geographical distribution of the population, as it may be said that more than three-fourths of the entire traffic problem consists of the movement of employees to and from work. In a study of this kind, it is indispensable to enlist the interests and cooperation of those agencies in possession of population statistics, such as the U. S. Census Bureau and the Board of Education. The information to be obtained as far as traffic is concerned, is the origin of people in traffic movement.

Since private automobiles constitute the greatest number of units to be found in our traffic-ways, the next item of information deals with the origin of passenger automobiles. The distribution of automobile registrations is roughly in proportion to the distribution of population, the most notable exception being the district directly adjacent to the central part of the city, in which there exists a disproportionately great ownership of passenger automobiles. If we knew, at this point, the most popular points of concentration of passenger-automobile traffic, we could visualize the flow pattern of the city's traffic movement, and if we should conclude that the economic status of the population, its nationality, and certain other characteristics will not change materially in the next twenty-five years, this chart could serve as a guide in locating major street improvements.

To provide the basis for immediate improvement in street appurtenances and regulation in the traffic plan, the pattern of traffic movement must be obtained. If a comparison is then made between the distribution of vehicular volume and the distribution of population and of automobile registration, it becomes immediately evident that traffic within the city is largely of its own origin, and, in fact, this is true of every community. As it is to be understood that traffic streams will follow the routes of least resistance, improvements can and should be made in accordance with a well-devised plan to accommodate the needs of existing origin and destination. In addition to being an indispensable aid in determining an adequate street plan and the order of accomplishment, the traffic-flow pattern provides the framework for the conduct of studies of traffic and accidents, as well as studies of the relationship between traffic and commerce.

A map of the distribution of traffic volume will not in itself provide all the information desirable regarding congestion and pressure. Traffic volumes must be related to pavement widths or facilities available for its movement, as an aid in determining the location of isolated bottlenecks and outstanding points of unbalance in the pattern. In Fig. 1, the variation of traffic density is expressed in terms of hundreds of vehicles per foot of net



© *Michigan State Highway Department*

FIG. 1. PLAN SHOWING TRAFFIC DENSITY ON PRINCIPAL ROUTES IN DETROIT, MICH.

Based on Volumes for Average Weekday of 24 Hours, for the Period from January 1 to July 1, 1936

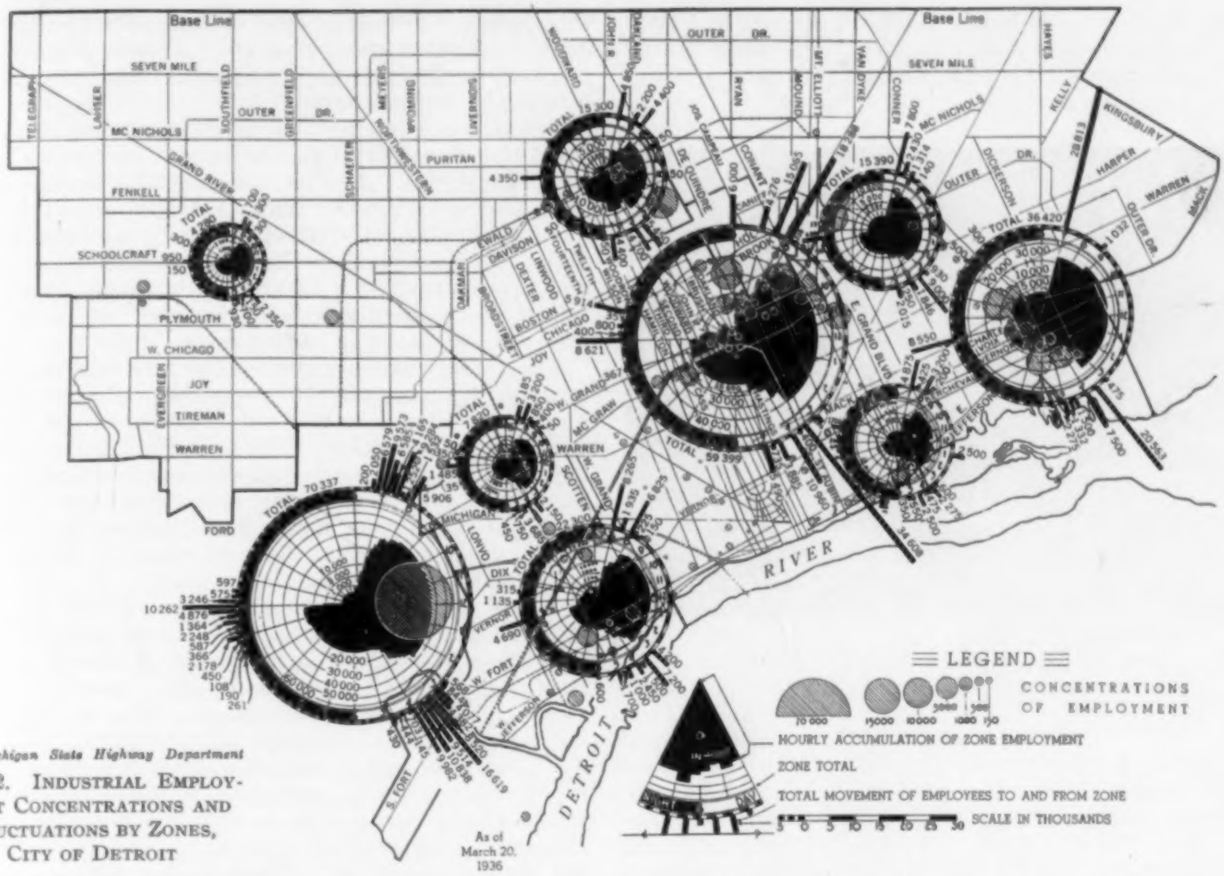


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Fig. 2. Industrial Employment Concentrations and Fluctuations by Zones, City of Detroit

pavement width. In those sections of streets which are here represented by the black areas, the ratios of vehicles to pavement widths are the greatest. These are not to be construed as points of congestion inasmuch as the vehicles used in the ratio are those which were observed to have passed in given units of time, and the points, therefore, are points of high performance and not necessarily of lack of facility. However, since lack of speed is one of the factors which indicate congestion, the highest points of congestion will generally be found adjacent to the points of high performance. A study of this kind is a valuable guide in the establishment of a greater balance of flow pattern.

Perhaps the best illustration of a desirable situation, both with respect to performance and fluidity, is to be found on the thoroughfare parallel to the water line in Fig. 1 (Jefferson Avenue). Here a great number of vehicles are carried per unit of facility for its entire length. This is not evidence of the desirability of widening the thoroughfare to lessen traffic pressure. On the contrary, it indicates that the street has reached a point of high utility, and has attained a high degree of balance throughout its entire length. The condition illustrated here is in great contrast to that on other avenues where the pressure varies considerably throughout their lengths.

Concentration of Industrial Employment

It has been pointed out that traffic is primarily the result of the movement of persons to and from places of employment. In some communities, nearly all of the population is connected with employment in the mechanical trades. In this investigation, it was found that over 332,000 were so engaged. The use of passenger automobiles is more common in the industrial districts than in the central business district. Industrial employees using automobiles ranged from 69 per cent of the total in the district shown in Fig. 2, in the lower left corner of the map (River Rouge), to 80.7 per cent in the large central concentration (Milwaukee-Junction), as compared with 30.7 per cent of persons in the central business district.

Referring again to Fig. 2, the solid area in the center of each large circle is proportioned in its extent to the total man-hours of employment of all the industries constituting the concentration in that zone. The shape of the outline of the central figure is fixed by the change of employment. The bars extending outward from the rim illustrate by their length the total number of employees involved in each exchange, and, by their position, the time of day. Demands placed on the adjoining street system by the simultaneous release of 75,000 employees (of whom 80 per cent are drivers of automobiles) would create a chaotic condition. Such a condition will be easily relieved, however, through a staggering of these releases. Since employment periods in the mechanical trades have little to do with the daytime habits of the population en masse, it should be possible for employers to arrange work periods to occur at any time during the day.

Perhaps the finest example of what is possible from a study of this kind, effectuated by the cooperation of employers, lies in a comparison of the manner in which the employees are released from the concentration shown in the lower left corner, with that in which they are released from the area indicated by the large central circle. In the first concentration, during a period of two hours (3:00 to 5:00 p.m.), there is a total exchange of 67,066 employees with a maximum movement of 16,619. In the second concentration, although 9,414 fewer persons are released in two hours than in the first case, a maximum movement of 17,989 more persons takes place than in the first group. It is obvious that congestion, causing accidents and loss of time, is worse in the second case than in the first. It is thus a part of any general traffic plan to establish and maintain, wherever possible, co-

operative effort to eliminate traffic peaks and to obtain greater uniformity of flow. Incidentally, improvements are obtainable from this phase of traffic planning without capital expenditures.

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TRAFFIC PLANNING MUST FIND A SOLUTION FOR THE PARKING PROBLEM BEFORE IT IS FURTHER INTENSIFIED

In addition to determining origins of pedestrian and passenger-automobile traffic, it is important to determine destinations. These are obviously at points of concentration of employment and of shopping activity. In Detroit a series of charts was developed to illustrate where the employees live in relation to their location of employment. These indicated a very general distribution of destinations throughout the area of origins, and would seem to suggest that crosstown thoroughfares or thoroughfares generally extending from the left to the right would be materially useful. A reference to Fig. 1, in which the flow pattern is shown, will indicate that approximately 75 per cent of the entire movement between origins and destinations of the industrial employees across the city takes place on but one thoroughfare. (Grand Boulevard).

ACCUMULATION OF VEHICLES AND PERSONS BY DISTRICTS

When the districts in which large accumulations of persons occur have once been located, the next step is to determine by field investigations further characteristics of traffic identified with them. By completely surrounding the area with a cordon of observers who count and classify traffic movements, it is possible to obtain the following data:

1. The number of each type of vehicle moving inbound or outbound in each half hour or other suitable period
2. Traffic movement, by streets
3. The accumulation of vehicles, by types, in the area
4. Street car and bus movements
5. The composition of vehicular traffic at any time of the day
6. The half-hourly or hourly movements of persons into or from the area
7. The distribution of persons among the various types of passenger carriers at any time of the day
8. The variation of movement of persons to and from the area throughout the day
9. The accumulation of persons in the area

The accumulation of vehicles and persons throughout the day will, in most instances, supply curves which will be practically parallel. This is due to the fact that the density of passengers per average vehicle is sufficiently constant to eliminate any great differences in the characteristics in the two curves.

The shape, as exemplified by Fig. 3, immediately portrays the character of the movement of persons to the area in question. In this case, since the investigations were made in connection with an area in which the movement of persons is the result of employment rather than of shopping activity, the accumulation of both vehicles and persons reached a value early in the day and maintained that value throughout the work period, receding thereafter to the point of beginning.

The traffic characteristics of the area can also be determined by comparing the accumulation curve with the hourly movements in and out of the area. Should the values of movements continue to be great throughout the day, it is an indication that considerable traffic enters and leaves, and there is little or nothing to attract such traffic in the district under investigation. But should such a study reveal that the hourly movements are large in comparison to the normal business transacted in the area and that the streets are congested because of this movement, it is evident that relief from such congested conditions may be obtained through a diversion of the hourly movements just mentioned, by means of bypasses around the concentration. This diversion will not injure business but will be of benefit to it.

The value of such a study is materially enhanced when repeated at regular intervals. A succession of such studies over a period of years will show not only the conditions as they existed at the time of the investigation but likewise the trends. These studies will indicate, in a measure, the extent to which the forces of decentralization have set in, in the case of the central area, or the extent to which the area has diminished or increased as a place of concentration of persons.

A further analysis of the mode of transportation employed by passengers will be of considerable interest to mass carriers, including street cars and buses. In the case of Detroit, the central business district has been subjected in the past fourteen years to decentralization, resulting in the operation to and from the district of fewer street cars and a greater number of passenger automobiles and in a considerable diminution of persons. Since this area is the location of this city's greatest concentration of retail establishments, it is apparent that decrease of accessibility is the cause of fewer persons visiting the district. Increased congestion in this case has not been the result of growth of population, but of increased use of the passenger automobile, which is more responsible than the street car for the creation of congestion and less efficient in the use of street space.

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DOUBLE PARKING REPRESENTS INEFFICIENT USE OF COSTLY STREET SPACE AND IS RESPONSIBLE FOR ACCIDENTS

The flexibility of routing, elastic time schedule, and high speed of the automobile have made it a favorite for urban transportation. But none of these qualities is of great consequence if terminal facilities are not provided, and the provision of such facilities has come to be a very difficult problem. The public demands free parking, either at the curb or elsewhere. Parking restrictions are flagrantly violated, and, in some communities, enforcement has been made extremely difficult through the Supreme Court's interpretation of local laws requiring personal service upon the operators of illegally parked automobiles. In such communities this requirement places a tremendous demand upon the personnel of the police department, and parking regulations are enforced only in limited areas through the use of tow cars.

PARKING PRACTICES, ACCIDENTS, AND SAFETY

A study of the conditions of parking, including the use of curb spaces and the existence and use of off-street facilities, is therefore an important part of the preparation of a traffic plan. The over-supply of off-street parking facilities in open lots in the central business district has resulted from a number of factors. Decentralization and obsolescence of buildings, together with high tax rates, have made it profitable to raze buildings and to devote the building sites temporarily to off-street parking. These factors plus the general cessation of business during the depression have resulted in provision for off-street parking for 32,000 vehicles, a number greatly in excess of anything that ever existed before, but which is diminishing because of business recovery and a revival of building construction. Investigations have revealed that while approximately 50 per cent of the parking at the curb is illegal, less than half of the berths in off-street facilities are occupied. A study of this kind is beneficial preparatory to passing legislation, as it determines to what extent laws can be enforced to eliminate curb parking in the interests of fluidity and safety.

In addition to increasing the fluidity of traffic, a traffic plan must work towards safety in its movement. As a means for focusing attention upon those locations where accidents recur, a map showing the location of accidents may be prepared. Unusual concentrations of accidents usually occur at intersections involving more than two streets. Fatal mishaps will occur in widely scattered sections, including residential streets of minor traffic importance. The information to be derived from an accident spot map forms a guide for authorities in traffic planning, indicating as it does, the places where enforcement activities should be concentrated as well as the location of particularly hazardous intersections which may be physically improved.

Just as the accident spot map shows the distribution of the occurrence of accidents, so a map of accident-prone districts shows the distribution of persons responsible for them. Automobile registration data and accident records are used to locate the residences of drivers involved in accidents. Dividing the number of accidents occurring in each district by the number of total registrations therein, the percentage of registration which participated in accident occurrence is obtained.

A study of this nature points toward a selective educational effort designed to reach those drivers having little sense of responsibility, who ordinarily do not respond to the usual type of safety education appeal. It also indicates that vehicle maintenance is below standard in districts where the population has a low income.

A few of the studies usually made to form the beginning of a traffic plan have now been reviewed briefly. They require large organizations of field observers, and for that reason are conducted only at infrequent intervals, when the required personnel is made available by special appropriation of funds. Through the proper interpretation of these and similar data, the traffic engineer

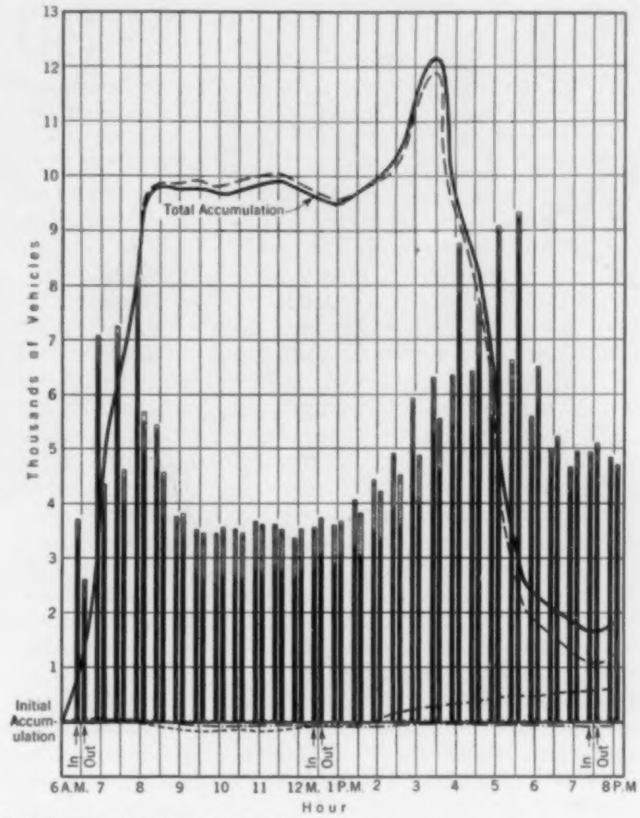

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Fig. 3. Summary of Vehicular Movements to and from the Milwaukee Junction Industrial District of Detroit

Showing In- and Out-Bound Movements by Half-Hourly Totals and Twenty-Four Hour Accumulation by Classes. Classes of Traffic Indicated Are Passenger Cars (Solid Black), Commercial Vehicles (Cross-Hatched), Street Cars (Stippled), and Buses (Solid White)

prepares a basic plan, which, to be effective, must receive popular approval. But even this is not all that is required. There should also be a definite assignment of responsibility for execution of the plan, and if persons who should assume that responsibility do not already exist in the community government, such officials should be appointed. The tenure of office of such persons or official bodies should be for such a time as is required to effect the plan. Such official activities should be made a permanent part of the community government, as it is the function of any government to ensure to the people the right of life in public areas, free from the dangers of uninformed, uncontrolled, and unplanned traffic.

REVIEWING FACTORS IN TRAFFIC PLANNING

To recapitulate, the fundamental factors to be considered in a traffic-planning program are the location of population, the types of residences, the concentration of population in residential areas, the location of industry, the location of offices, and the concentration of population in offices and retail establishments. The relation of these factors to one another, and their influence on congestion and accidents make up the traffic problem.

One last caution may be added. As long as traffic engineers think of the traffic problem as something isolated from the general plan for community development, just so long will the problem remain unsolved.

A Foundation Primer

Demonstrating Facts and Fallacies, Especially as Applied to Small Buildings

By Jacob Feld

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GUESSING, more or less intelligent, has too often been the basis for constructing building foundations, particularly in establishing a value for bearing power of soils. Structures of great size or monumental character have received ample scientific attention, but smaller buildings, to which this paper primarily refers, have been founded according to the judgment or experience of the designer. Dr. Feld presents a more rational basis. Treating the different materials encountered, he points out the limitations and peculiarities of each, with practical suggestions for avoiding pitfalls on the one hand, and taking advantage of favorable qualities on the other. Losses from settlement or failure, he claims, are of such magnitude as to justify precautions equal to those required for fire hazards. This paper, based on ten years' experience with foundation repair jobs, especially in and near New York City, will commend itself for its practical viewpoint.

WHILE careful study is invariably made for the foundations of important buildings and skyscrapers and a great deal has been written about their actual design and construction, there is practically nothing in technical literature on similar features for small buildings. This is unfortunate since small buildings are much more numerous than large, and their total value is greater. Very seldom is a foundation specialist given an opportunity to design foundations for a small building. On the other hand, most of the foundation failures have occurred under small buildings, and the repairs of the resulting damage have given sufficient examples of why building foundations fail, to permit the statement of certain rules and regulations which can act as guides to the proper design of such foundations.

Under the classifications of small buildings may be included such structures as frame dwellings, non-fireproof brick apartments varying from two to six stories in height, office and factory buildings up to about six stories in height, both non-fireproof and fireproof, small public and institutional buildings, and garages. Buildings of this type have a total load, dead and live, of from 250 to 1,000 lb per sq ft of area occupied.

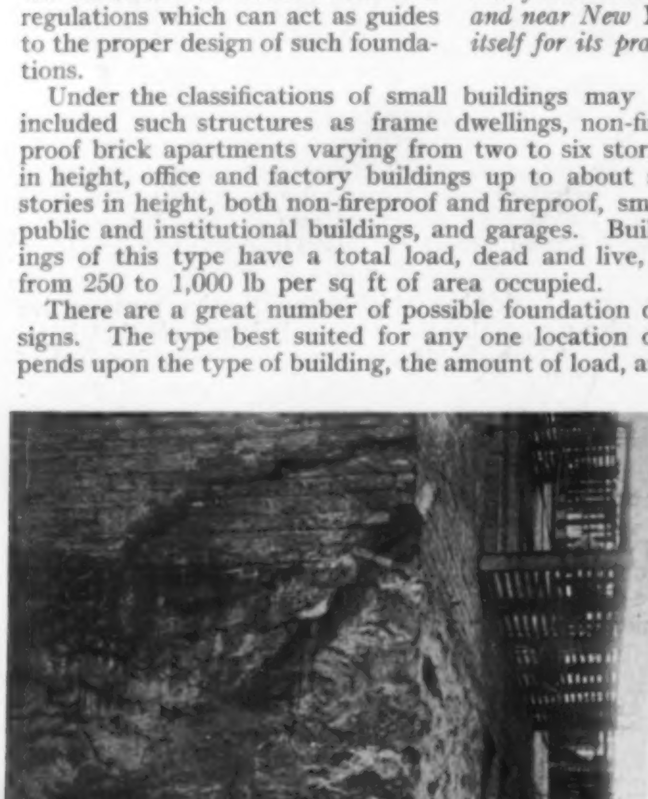
There are a great number of possible foundation designs. The type best suited for any one location depends upon the type of building, the amount of load, and the nature of the subgrade material.

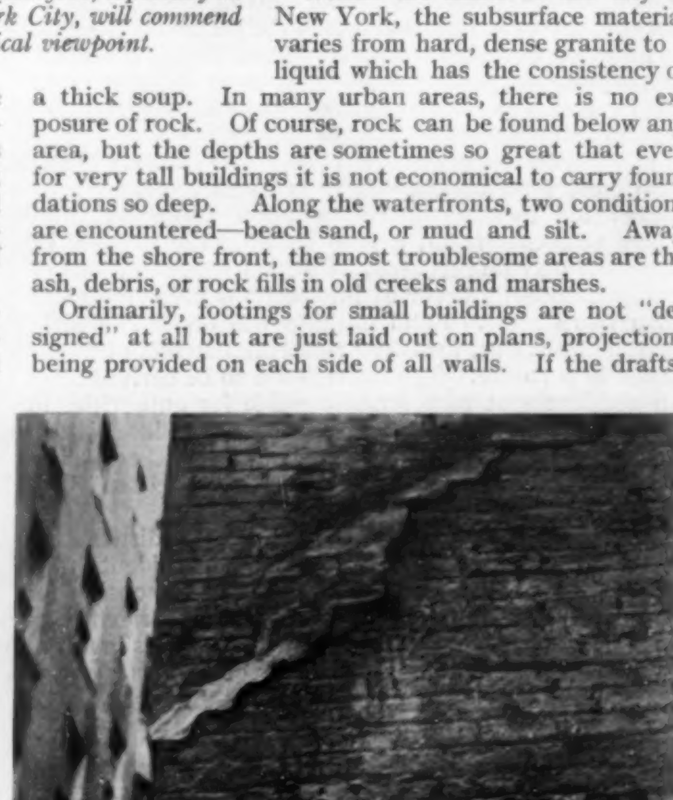
In general, it seems as if the people responsible for the design of most buildings disregard each of these items in deciding on the type of foundation to use. The result, in the great majority of cases, is an over-designed foundation, which is a waste of money, or, for a large number of buildings, failure of the foundation. As a result of such failures, there are cases of buildings settling as a unit or tipping, of walls cracking in diagonal fashion, of walls warping out of plane, of sloping floors without any exterior signs of distress, of separations of portions of the building from the main structure, and similar problems.

SOIL AND FOOTINGS VARY

Within the limits of the city of New York, the subsurface material varies from hard, dense granite to a liquid which has the consistency of a thick soup. In many urban areas, there is no exposure of rock. Of course, rock can be found below any area, but the depths are sometimes so great that even for very tall buildings it is not economical to carry foundations so deep. Along the waterfronts, two conditions are encountered—beach sand, or mud and silt. Away from the shore front, the most troublesome areas are the ash, debris, or rock fills in old creeks and marshes.

Ordinarily, footings for small buildings are not "designed" at all but are just laid out on plans, projections being provided on each side of all walls. If the drafts-

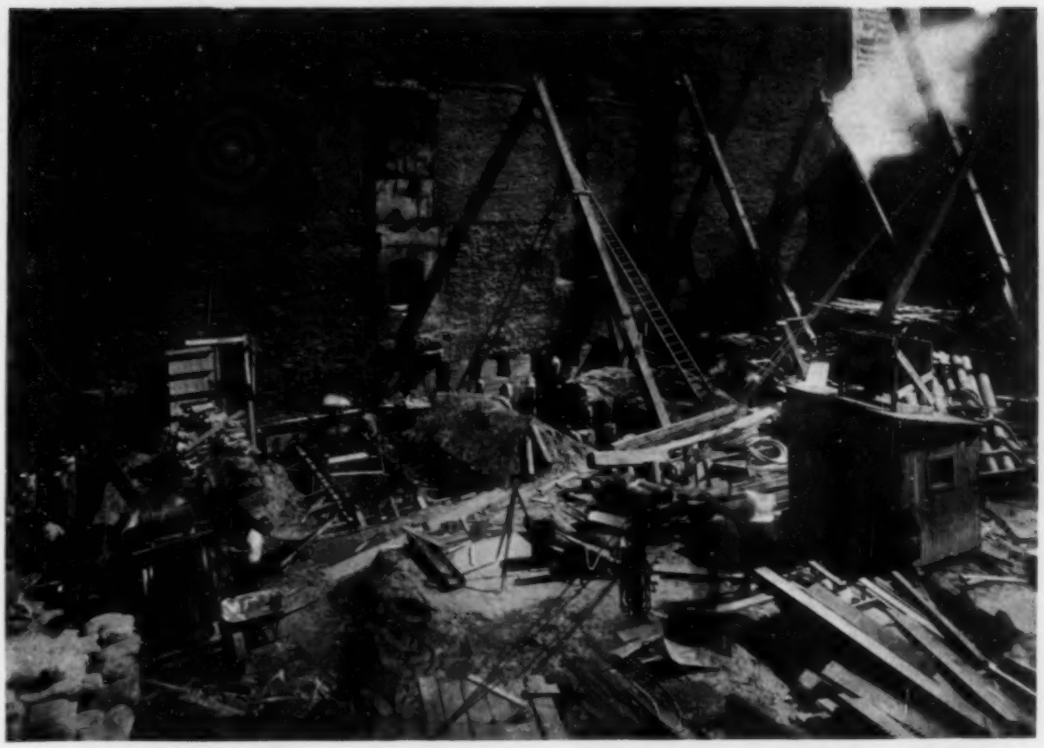




Graphic Example of Results of Settlement

A Six-Story Wall-Bearing Apartment Resting on Piles in a Single Line with no Lateral Stability. Two Sides of the Same Corner Showing How the Wall Has Tipped

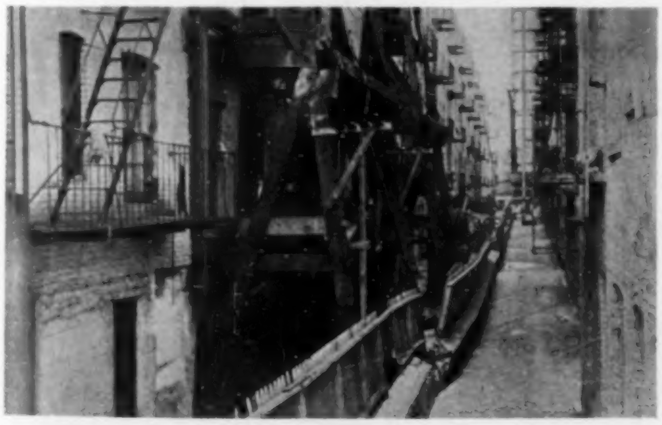
man had recently seen examples of failures, he makes the projections correspondingly larger. Where any computations are made at all, footings are designed on the assumption that the total load divided by an assumed bearing value of the soil gives the area of the required footing. There are practically no examples on record of footings having failed because of the structural defects of the footing itself. The chief causes are incorrect estimates as to bearing value of the soil, wrong assumptions as to the average load acting on the footing in cases of non-centric application of loads, and disregard of the effect of relative depth of excavations on bearing value in adjacent footings. This last item is especially important in weak soils where footings may be required at special depths and where no precaution is taken in providing lateral support for the material under the high footings.



EXAMPLE OF PROPER METHOD FOR GUARANTEEING THAT ECCENTRIC EXTERIOR LOADS WILL NOT GIVE ECCENTRIC PILE REACTION

Structure Is Steel Frame Office Building in Lower Manhattan. All Exterior Pile Clusters Are Combined with Interior Groups

Taking up the various types of subgrade in detail, it must be borne in mind that subgrade materials may change with time and especially after the sudden exposure to the elements, resulting from excavation. For instance, hard blue clay may change to a fluid mud after a single heavy rainstorm. Manhattan schist, perfectly hard when exposed, may have veins or surfaces of weakness through which water can easily seep and cause serious sliding. On the other hand, it is possible to perform certain operations on very weak soils and thus increase their bearing values appreciably—for example, by surrounding areas of soft silt with sheet piling and compacting the silt within the sheet piled area, by reducing the amount of water in saturated soils through drainage, and by some recently developed chemical methods for decreasing the voids and increasing the rigidity of soils.



ILLUSTRATING THE COST OF CORRECTING TIPPING OF WALLS ON PILES

Timber Jacking Frames Used to Support and to Plumb While Additional Rows of Piles Are Being Placed for Stability

EVEN ROCK PRESENTS PROBLEMS

Where small buildings are founded on rock, whether hard or of the classification known as medium hard, no special precautions are required as long as (1) the rock is sound, (2) it will not disintegrate when wet, and (3) there are no faults or disintegrated surfaces in the rock itself. In certain sections of upper New York City, there is exposed rock with cleavage planes at considerable angles from the horizontal—in some cases as much as 75 deg. The value of such rock as a foundation material is practically zero, because any addition of load and, in some cases, even a slight jar such as is caused by blasting in the vicinity, will loosen up the various layers and cause sliding. Fairly often buildings are located on top of such rock cliffs, adding the danger that excavations at the base of the cliffs will undermine the rock layers, with disastrous results.

Actual examples are on record, where buildings on such rock layers have suddenly moved and, in some cases, practically collapsed. To avoid such danger, it is often necessary to tie the entire mass of rock together by drilling holes through the various layers, including at least one layer that will not be disturbed from either undermining, blasting, or water seepage, and by grouting steel dowels into these holes. The number of dowels required can be computed approximately by assuming that they carry the total weight of the building or by considering that the rock sheets carry the full weight of the building and then calculating the amount of shear resistance required between the successive layers so that the entire load may be safely transferred to the undisturbed layer.

In certain areas of the Bronx and Manhattan, espe-

Immediately After the Failure, Looking Up

Repairs Under Way, Looking Down

RESULT OF UNDERMINING BUILDING ON ROCK CAUSED BY LOOSENING OF SEAMS DURING EXCAVATION FOR BUILDING AT LOWER LEVEL

cially in locations such as the Jerome Avenue trough and south of the sudden rock slope near 23d Street, Manhattan, as well as in a number of old creek locations, there are large accumulations of boulders which, after boring investigations, are often reported as rock. In a number of instances, pits dug for isolated footings have been stopped at the top of such boulders and called rock bearing. For small loads this practice is not dangerous, but special precautions should be taken in cases of large load concentrations. When borings or pit excavations indicate a rock surface with great variations in the same plot, core borings should be taken to prove that the rock is ledge and not large loose boulders.

USE OF SAND FOUNDATIONS

It is not usually appreciated that up to about 1880, all foundations for heavy buildings were single continuous beds of masonry covering the entire area of the supporting ground. Isolated footings for column or pile foundations originated at about that time and caused a great deal of discussion as to their advisability. The first reinforced-concrete footing consisted of steel I-beams laid in the form of a grillage encased in concrete. In 1881, the Montauk Block Building in Chicago was built with concrete isolated footings in which were embedded steel rails. This is the origin of the modern reinforced-concrete spread footing, which is now used more than any other type of foundation support.

Subgrade material usually called sand is much less variable than that called clay. It may be beach sand, bank sand, or a mixture of bank sand and gravel. The last classification includes the condition where the gravel is as large as boulders. A compact and sometimes cemented sand and gravel, often classified as hardpan and usually glacial in origin—a material that will safely carry 6 tons per sq ft—is a good foundation material. Except in unusual cases of heavy wash from rains, the material will stand practically vertical for heights up to 10 ft. It will carry six tons with practically no settlement; in some classifications and building codes, a much higher bearing value is allowed. The important danger to guard against is the usual occurrence of much finer sand, sometimes saturated and tending to fall into the classification of "quicksand," which underlies such glacial drift accumulations in the vicinity of terminal moraines.

When digging pits or footings in this type of material, it is often specified that the subgrade surface should be level. Inspectors interpret this specification to mean the removal of any boulders that may project above the subgrade levels. This requirement weakens the soil by destroying its natural compactness and because very often the space formerly occupied by the boulders is back-filled with a material of much lower bearing quality. In general, natural soil is better than any material, with the possible exception of concrete, which can be put in to replace it. The practice of breaking off projecting boulders by blasting or cracking, should not be permitted, since it weakens large adjoining soil areas.

MATERIAL FOUND IN LAYERS

Hardpan layers overlying quicksand or other poor materials—a condition found in parts of White Plains, N.Y., and other locations—can often be safely used as a foundation. The criterion of safety is the average load at the bottom of the hardpan layer.

The foundation is safe if: (1) The total added load is less than the weight of the excavation removed; and (2) the thickness of the hardpan layer is sufficient to distribute concentrations of load.

For small buildings a layer 6 ft thick is sufficient. For loads below 10 tons per sq ft, the amount of settlement on hardpan is independent of the size and shape of footings and depends only on the loading concentration. In other words, the hardpan acts as an elastic material and a settlement of somewhat less than $^1/_2$ in. is to be expected.

Glacial deposits of sand and gravel are often found above deep sand layers. Advantage should be taken of such glacial material as a distributing layer, similar to hardpan, even when overlying very poor material such as fine running sand. Based on boring data, such a condition often results in the recommendation to resort to a pile foundation—a frequent error. Not only will it be difficult to drive piles through the sand and gravel layer, but when and if piles are driven, they will depend upon the soft underlying sand for bearing. The result is an expensive and poor foundation. As long as the total weight to be placed on the sand-gravel layer will not

overload the underlying sand, spread footings should be used. In estimating the load that any layer can carry, the weight of the superimposed layers, which have been and are being carried, should be taken into account.

SAND BEHAVIOR UNDER LOADING

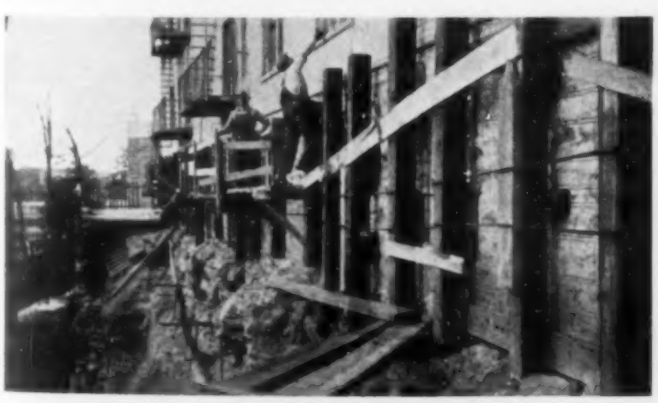
Sand is a conglomerate mixture of hard, irregularly shaped grains in partial contact, chiefly characterized by its internal frictional resistance. An application of load tends to decrease the volume of the mass. Such decrease is accomplished by actual elastic compression of the grains, by crushing or shearing of edges, by redistribution of grains, and by reduction of voids. The action occurs under the full-loaded area of contact, but not (as is always assumed) uniformly. Experimental work is being carried on to determine the effect of various factors, but it is far from complete. However, we do know that in sand:

1. For equal unit pressures up to a maximum of 5 to 6 tons per sq ft, smaller settlements will result from smaller total footing areas; from footings with greater edge length per unit area; from deeper footings, when built in undisturbed pits; and from footings further removed from loaded area.
2. All footings will settle—the average amount for loads under 4 tons per sq ft will be about $^3/_4$ in. and will occur almost instantly upon application of the load with practically no further variation.
3. After the load is applied, sand will not change its bearing value unless undermined by the removal of lateral support.
4. The carrying area under a footing remains constant with time and practically so with varying water content; it depends only upon the coefficient of internal friction of the sand.
5. The bearing under a footing is not uniform, being more concentrated in the inner areas, but the actual distribution of pressure is such that the assumption of uniform distribution results in safe designs.

IMPROVING BEARING ON SAND

The problem of designing foundations on sand is fairly simple. The chief precautions required are to prevent loss of sand from underneath footings and to so place adjacent footings that no pressure area is seriously disturbed or affected by the loading of any other area.

As far as loss of sand is concerned, the problem seldom occurs except in foundations near waterfronts. In such locations where there is danger of wash from current or waves, interlocking sheet-piling, properly driven to depths below possible disturbance and tied back to interior footings, is a necessary precaution.



Exterior Wall of Upper Building Tied to the Affected Rock Layers

During Underpinning to Replace Disturbed Foundations. Layers Are at 70 Deg from Horizontal

The effect of water on sand is to change its density. Sand with approximately 10 per cent water (by weight) occupies a minimum space. Increase or decrease of this percentage will increase the volume. This property of sand is quite important. Structures supported on saturated sand, which is later drained, must settle. Ordinary draining of sand does not remove all the water—only that amount above the percentage which gives the minimum volume. Structures on dry sand, which becomes wet, will also settle. Fortunately, such changes are usually quite uniform for any structure and so cause no great damage.

Typical Case of Re-Use of Old Bridge Abutment

Building Foundations Can Often Be Re-Used in Similar Fashion, Especially in Weak Soils

There is a great difference between sand and silt. Sand consists of grains of silica, hard and tough. Beach sand consists of spherical grains fairly uniform in size. Bank sand grains are of various sizes and shapes and pack into a denser mass than beach sand. Silt is a much finer material, containing a considerable percentage of flat flakes of mica, often coated with colloidal clay or colloidal silica. From the point of view of physical action, silt is very much like clay.

The presence of colloids does not always mean that the soil has a poor bearing value. There are certain sand banks on Long Island, which contain sand grains covered with colloidal silica. Such sand is worthless for concrete because the cement will not stick to it. However, it is extremely dense and when used for fills becomes hard and compact in a very few years. The natural cementation process caused by rain and the colloidal silica is very beneficial. It is advisable to take advantage of such action in filling areas composed of poor soil.

PECULIARITIES OF CLAY AND SILT

Clay is chiefly characterized by its low frictional resistance, although it often has great cohesive strength. The particles are mostly flat, often arranged with faces parallel and separated by films of water or colloidal solutions. Application of a load on the clay squeezes out the water, and consequent settlement occurs—not suddenly, as in sand, but continuously with decreasing amounts as a resistance is built up because of the increase of capillary and cohesive stress due to the decrease of voids. Under ordinary conditions of loading, about 75 per cent of the settlement occurs in one year and the final position is practically reached some five years later.

Because of the many variations in clay soils, much less is known of their action than is known of sand. How-

ever, one fact is certain—changes of water content cause most of the trouble in clay soils. As limiting examples, we have the percolation of water through a clay bank forming a weak plane along which all the material above

CLUSTER OF STEEL PILE SHELLS DRIVEN IN FILL TO ROCK
Unless Braced to Adjacent Footings, This Type Has Little Lateral Strength

will slide; and at the other extreme, the case where water pressure is built up under a clay blanket until it breaks through a fine silt making the mass apparently alive or "quicksand." When flow of water, no matter in what small amounts, can occur through clay, a dangerous condition exists.

PRECAUTIONS ARE NECESSARY WITH CLAY

Where structures must be founded on clay, the following special precautions are advised:

1. Place all footings on the same clay layer and practically at the same elevation.
2. Footings are affected but little by live loads; unless such loads are always present, design them for equal pressures from the continuous loadings.
3. Assume that footings with a greater ratio of edge distance to area will settle slower and probably less.
4. Prevent water flow near the foundations by cut-off walls and drains.
5. Investigate the clay for several feet below the subgrade for weak layers.
6. Do not expect that piles in clay soils will carry load without settlement.
7. Provide for future settlement by either jacks or wedges on footing or by building above the desired elevation. The amount of settlement to be expected can, at the present state of our knowledge, best be determined by inspecting old structures in the neighborhood.

Such materials as garden soil, fill, and humus should not be used for foundations. If such use is unavoidable, it is best to excavate deeper and fill the foundation with sand and gravel to a width at least twice that of the footings and at least 2 ft in depth. The footings are then to be designed for a bearing value of no more than 1 ton per sq ft.

Where an existing structure is being removed and soil has a very poor bearing value, it is advisable to study the possibility of re-using the old foundations. I have successfully applied this idea in several locations, with considerable saving in final cost and with practically no observed settlement. Of course, it is essential that the new loadings be no larger than the old and that the loads be distributed in somewhat similar fashion.

Any kind of footing on rock will not settle. Any kind of footing not on rock will settle. The amount of settlement depends on the soil but, of course, it can be controlled by the size of the bearing area provided.

Spread footings, carrying one or, at the most, three-column loads or a symmetrical condition of wall loading, can be used for any soil. Where eccentricity of loading occurs, proper beams must be provided to carry balancing loads. The value of piles is to save excavation and to transfer loads through poor soils to good soils. If this principal is remembered, more rational use of piles will result.

WHY DO STRUCTURES SETTLE?

Structures do not settle because the foundation has failed, but because the subgrade under the foundation is adjusting itself to new conditions. If the loading on footings is fairly uniform and symmetrical, settlement will often not be noticed. When non-uniform settlement occurs, buildings show signs of distress, so that this type of settlement is most serious.

The chief causes of non-uniform settlement are as follows:

1. Non-symmetrical loading, especially in clay soils.
2. Action of water under part of a structure, possibly due to the construction of a cut-off by a neighbor.
3. Non-uniform soil layers, some footings bearing on better soil than others, possibly large boulders or even rock.
4. Some footings carrying load from adjoining higher footings in addition to their own loads.
5. Footings resting on soil which has been disturbed during construction or later by such works as sewer trenches.
6. The drag caused by settlement of an adjoining building in physical contact.
7. Unbalance of loading due to tipping of pile foundations not properly braced.
8. Piles resting on clay layers of non-uniform strength, the sudden concentration of loading causing failure of the clay.
9. Footings at various depths, some of them affected by tide action.
10. Disintegration of rock under exterior footings where poor rock is exposed.
11. Overloading of adjacent ground, especially in clay soils.
12. Removal of groundwater by nearby excavation or construction.

This list is not a hypothetical one, but is made up from reports based on my examinations of buildings which showed distress from non-uniform settlement. The cost of repairs, in most cases, is far in excess of the original cost of a proper foundation.

The results of non-uniform settlement are quite well known. Greater depreciation of structures, even though repair of damage is careful and continuous, is an item often disregarded. It is the item which will probably have more weight in preventing the continuation of poor foundation design and construction than any other because it has a financial bearing.

Let me leave one thought for discussion—the total money loss caused by necessary repairs from unequal settlement is probably greater than that caused by fire loss. Why then do the mortgage holders insist on the inclusion of certain items of construction to reduce fire hazard and make no attempt to control the design and construction of the foundation for most buildings? Proper care in foundation design and construction is a cheap insurance against rapid depreciation and excessive repair bills for any building, no matter how small.

Problems in Structural-Steel Erection

Some Practical Suggestions Looking Toward Ease and Speed in Steel Building Construction

By William G. Rapp

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Prior to beginning the actual field work of structural-steel erection, decisions should be made as to methods of shipment and delivery of steel, the kinds of derricks to use, divisions of shipments, and the types of hoists most suitable. In addition, thought must be given to such seemingly unimportant details as foundations, blocks, cables, and slings for derricks, and equipment for their removal after completion of the work. Much valuable information of a practical nature is included in the accompanying article by Mr. Rapp, emphasizing the fact that a satisfactory erection job depends almost as much on the smooth planning of the work in advance as it does on skill in the actual execution of it.

In the erection of steel structures, thorough consideration must be given to many different factors, and decisions must be made long in advance of the actual field work. The principal question which must be determined is the method of erection.

Taking buildings, for example, the steelwork for the average tier building is erected by means of one or more guy derricks, but occasionally conditions warrant a stiff-leg derrick, or a traveler with a derrick mounted on it. The latter scheme is generally practicable only when two travelers can run alongside each other, one jumping the other at the end of the run—unless special derricks are set up at each end for performing this task. Another way to obviate the need for jumping is applicable very occasionally, when a section of a building can be erected to the roof and a traveler set up there. The traveler then erects all floors from ground to roof as it travels. Again, a derrick can be mounted on a fixed tower outside of the building site—this was done in erecting a hotel at Hot Springs, Va., several years ago.

If it has been decided to use a guy derrick, an investigation must be made of the heaviest load to be handled. The size and capacity of the derrick will then depend upon handling this load at the reach necessary to set the piece in place, or upon the reach for picking the piece from the delivery trucks or cars, or possibly, in some cases, upon handling a lighter load at a greater reach.

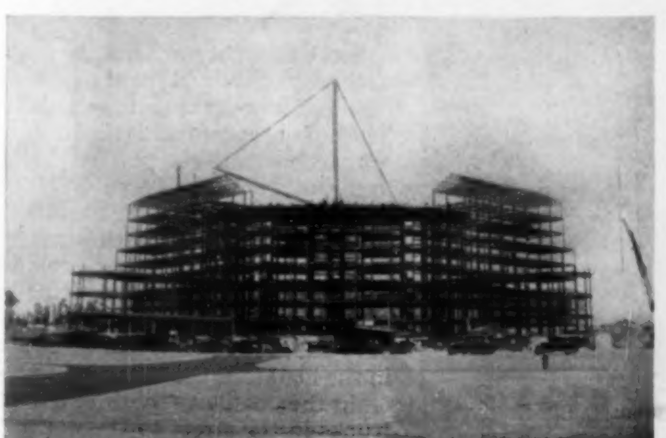
In any case, having chosen the derrick, the permanent structure must next be checked to determine whether the beams on which the derrick is to be set are of sufficient strength to carry the combined load of the piece to be handled, the derrick itself, the lead-line pull of the cables leading down through the derrick foot-block to the hoisting engine, and the pull of the guys transferred through the mast. If the beams are of insufficient strength (as is often the case in a light building, or in a heavy building with one particularly heavy load causing excessive concentration of stress under the mast) then one of three plans must be adopted. These are (1) to "heavy up" the beams by replacing with temporary beams of greater section, (2) to replace with similar heavier section members, to be left in place as permanent members, or (3) to shore to the steel below.

The latter plan requires the checking of the beams below (on which the shores would rest) to determine if they have the strength needed to carry that share of the derrick load computed to be transferred through the shores. The seven or eight guys from the head of the mast must be so arranged that, in setting heavy members or in picking loads from the street or other delivery point, the load preferably stresses at least two guys.

A check of the floor system is then made to see if it will transfer the horizontal stresses between the points where the guys are fastened and the foot of the derrick, which of course must be thoroughly shored or guyed to the structure by means of horizontal "kickers." In computing such stresses it is always assumed that the floor system has enough bolts or rivets already in place to transfer the loads. The derrick guys must be checked for the size required to take care of the stresses due to such factors as the distance of the lower end of the guys from the foot block, length of the mast, and distance to be boomed out with various critical loads.

Locations of Hoists Require Study

A study must be made of local conditions—of the general contractor's proposed equipment layout and the architectural features of the street floor and walls—to



Guy Derrick Erecting Steel

Grillages for Tier Building

A "JINNIWINK" IS OFTEN ECONOMICAL FOR SETTING THE LAST PIECES IN PENTHOUSE OR ROOF

enable a proper decision to be made as to where the hoisting engine should be located. A good plan is to place the engine in the street when local ordinances permit, leaving it there until some of the street-level steel has been erected and then moving it into the building at that point. This eliminates the need for and the hazard of having the hoisting cables cross the sidewalk, but sufficient brick or stone must be omitted to permit the removal of the engine upon completion of the work. Locating the engine in the basement is a poor plan on account of the need for expensive rigging for lowering it into place (unless a ramp is available) and the far greater cost of removing the engine at the completion of the job.

On very tall buildings it is sometimes advisable to set the engine on an upper floor in order to reduce the length of the running cable between the hoist and the derrick. In this case, the engine is placed on a setback whenever possible, in order to make its placing and removal as easy as possible. On a building of this type it is often advisable to have a relay derrick part way up. A stiff-leg derrick is generally chosen for the purpose, as this design permits the mast to be set so much closer to the edge of the building than a guy derrick that the length of boom can be much reduced. Also, with the many setbacks found on a very tall building, it is often necessary to set the mast so far back from the street that a guy derrick would require a boom far too long for safe and speedy operation. In addition, guys would materially hamper and possibly foul the erecting derrick falls in picking the loads from the relay platform and transferring them to the working floor.

It is good practice to decide next how the steel shall be divided for shipment. Ordinarily columns are shipped in two-story lengths, and steel for these two floors should be shipped at the same time. Occasionally it is desirable to ship an exceptionally heavy column in one-story lengths instead of in a two-story length. Although this requires field-splicing of the two pieces, as well as additional shop work, it permits the use of a smaller, lighter derrick on the job, resulting in increased speed and efficiency in the erection of the rest of the structure, and effecting a total saving far greater than the cost of cutting the column into two pieces and driving the additional field rivets. As steel is generally shipped in carload lots averaging a little under twenty tons, the pieces in such lots are generally well mixed. Before actual erection is started it is necessary to sort out all the pieces, distributing them on the floor under their approximate permanent location.

Wages in the field being considerably higher than in the shop, it is a good plan to so detail and load the material that some sorting is automatically done in loading at the plant. In this way, it is often possible to have the material for each section of the floor loaded into separate cars. Then when the steel is transferred to trucks and hauled to the site, these divisions can be maintained and the steel unloaded in its proper sections. Another method consists in the use of a properly selected set of erection marks, using numbers from 100 to 200 for one section of the floor, numbers from 200 to 300 for another, and so forth. Even though the pieces may be delivered to the job badly mixed, these piece marks will expedite sorting.

Often the problem arises whether (1) to ship steel by rail to a nearby point and there unload with mobile crane, caterpillar crane, truck crane, or locomotive crane, and haul a short distance to the site, or (2) to deliver under a railroad gantry or similar crane a greater distance away, involving a longer and more expensive haul but possibly far smaller unloading charges. Where practicable, it is often advisable to deliver by derrick lighters (often furnished at a very nominal fee by the railroad company), using a boat derrick to load trucks at the dock. This latter method is the one generally preferred by the truckman, as truck loading is thereby materially simplified. It will usually result in the truckman's reducing his hauling fee below what he would charge were he himself to do the unloading from cars at a terminal (even though the length of haul in the latter case might be considerably less), because his trucks will be kept standing a much shorter period if the unloading is done from lighters.

CATERPILLAR CRANE ERECTING A SIX-STORY STRUCTURE
Caterpillars Are Generally Used for Construction of Low Tier Buildings

PROBLEMS OF POWER AND FUEL

Some thought must now be given to the capacity and type of the hoists required for operating the derricks. The advantages of using a light hoist with a low lead-line pull, requiring many parts in the boom and load falls, must be balanced against those of a heavier hoist with stronger lead-line pull, using fewer parts in the falls and probably resulting in faster erection. If the building is very tall, the fewer parts there are in the load falls the quicker, in general, the load can be lifted from trucks in the street to the working floor and the less the time the raising gang is kept from productive work.

A choice of power must also be made. Under certain conditions, electric power may be a real advantage over gasoline or steam. Where such power is not readily available, or the installation cost prohibitive, gasoline may be preferable, although a gasoline hoist has numerous disadvantages in comparison with an electric hoist, especially in extremely cold weather. Riveting equipment should be taken into consideration at this time, as provision must be made for an air compressor. Should it be driven by an electric motor, or by gasoline, steam, or fuel oil? Local or job conditions often influence this decision, but the hoisting and air-compressing equipment are usually similarly powered.

Tools must be thoroughly lined up. Many jobs are well planned and well directed, but fail miserably to come up to expectations of progress and efficiency on account of poor, improper, or insufficient tools. Many other apparently insignificant items must be anticipated and watched. Good coal is necessary for good riveting. Arrangements for the installation of electric power must be made or, if gasoline or fuel oil is to be used, sources must be developed.

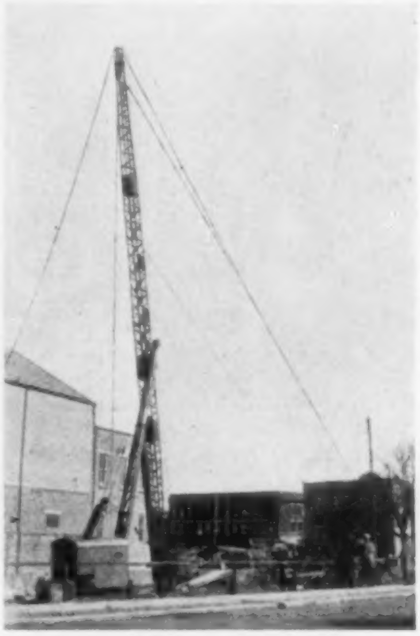
Permits must be secured in ample time to avoid serious and expensive hold-ups at inopportune moments. Local ordinances and police regulations must be consulted if it is anticipated that work will be done at irregular hours, such as on Sundays or at night. If the work is for the federal government, or if specifications or contractual obligations so require, it is vital that all necessary approvals be secured in advance so as not to hold up the work when everything else is ready to start. Contact must be maintained with the foundation contractors so that steel, equipment, and men are not sent to the site too early to do any work. Nor should these be sent so late that the work of other trades is unnecessarily held up, waiting for steel erection to begin.

It is a good plan to endeavor to have grillages, slabs,

Truck Cranes Are Ideal for Unloading and Assembling Guy-Derrick Sections and Rigging

and loose column bases shipped to the site simultaneously with, or directly after, the receipt of the derricks. By so doing, the instrument work necessary for setting can be going on while the derricks are being set up, and base slabs or grillage beams can be set in place and grouted. In this way all will be ready for the erection of columns by the time the derricks are up and ready to work. Otherwise considerable time may be lost between the complete setting up of equipment and the final hardening of grout under slabs. Where anchor bolts are called for in the foundations, it is necessary that such bolts be shipped sufficiently far in advance to be incorporated in the concrete at the proper time.

In setting up a guy derrick it is important to have good anchorages available. Foundation footings are frequently of sufficient weight and resistance to sliding to permit installing an anchor for a derrick guy. It is always a good plan, where possible, to arrange to place "hairpin" anchors in such concrete footings where the weights will be sufficient and the locations satisfactory for use as derrick-guy anchors at the first set-up, or possibly for use in tripping up the boom. These anchors are embedded about 3 ft in the concrete, the loop being left about 6 in. above the top of the footing. Where there is a good rock foundation but the concrete footings are too light, split-ended eye-anchors can be driven into holes drilled in the rock, and then grouted, at points where guys will be used.



Truck Crane Setting Up Guy-Derrick Mast

Small details, too, must be carefully watched and anticipated. For lifting exceptionally heavy members, sturdy slings must be made, or possibly "girder dogs," or a special hitching device may be used. If the latter, it must be fabricated in time to be ready for use when needed. Possibly it will be decided to have hitch angles fastened to the piece, and in this case the decision must be made before detail drawings are sent to the owner's engineer for approval, since additional holes are occasionally required. Approval may also be required for riveting such angles and for burning off their outstanding legs after erection. Or possibly holes which would otherwise be filled with shop rivets must be indicated on the detail drawings as for field rivets, to permit their use for bolting the hitching devices.

Cable lengths for the derrick falls must be computed and arranged for. Blocks must be looked over to insure that they are in a satisfactory condition. Compressors must occasionally be overhauled and pneumatic tools put in shape. Fitting-up bolts must be listed and secured, to permit the steel members to be erected with temporary bolts, used later to help pull the connections together tight enough to enable rivets to be driven satisfactorily.

Construction of Temporary Working Floors

If the building is of open-panel construction, some arrangement must be made for the installation of cables, timbers, or steel beams to span the wide openings, so that the permanent steel can be safely landed on planks laid on such supports, and the men can be provided with a safe working floor. The planks ordinarily used for temporary floors have insufficient strength to span "open panels" (about 20 by 20 ft or larger) and to support the men working on them, let alone the steel which must be landed on the floor for sorting and distribution previous

to actual erection. Where practicable, cables and turnbuckles connected by hooks fastened over the top flanges of two beams at opposite ends of a floor will provide a safe and inexpensive intermediate support for the planks and skids on which the steel is to be landed.

Another simple method is to make temporary use of beams destined for the upper stories, by punching additional holes at intermediate points and connecting them between the permanent members. As soon as the derrick has been jumped and the planks removed from the floor, the temporary steel beams are promptly removed and placed in their permanent locations, leaving the open panel floor as designed.

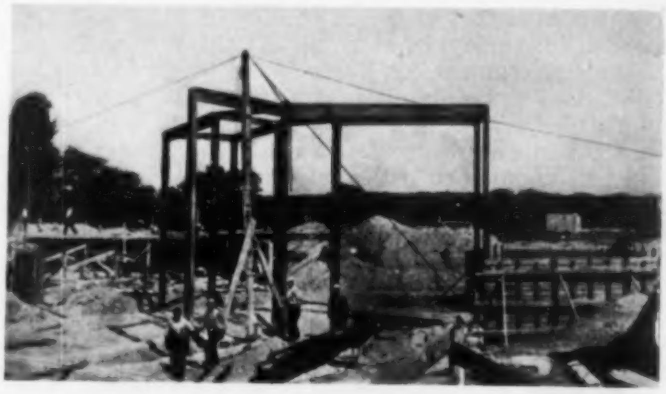
UNLOADING IN THE STREET IS OFTEN ACCOMPLISHED EXPEDITIOUSLY BY THE USE OF A TRUCK CRANE

Some thought must be given and plans laid for removing the derrick upon completion of the work. The most economical device for this purpose is a "jinniwink," the various members of which are individually so light that although a derrick is used to set it up in place on the roof, the men can later dismantle it by hand and easily load out the various sections. By using the derrick boom and load cables, the jinniwink can be reeved up for operation by a power hoist instead of by a hand crab. The sections of the derrick mast and boom can then be dismantled readily and lowered into the street for loading on trucks or for temporarily storing and later loading by truck cranes or other means. The jinniwink can then set the few pieces in penthouses or roof which are usually omitted up to this point to make the removal of the guy derrick easier. It is also used occasionally to erect pieces at levels which the derrick could not reach without jumping to the roof.

On mill buildings and on low, tier buildings, it is often expedient and economical to use equipment other than stiff-leg or guy derricks. When a crane of the caterpillar type, or mounted on a truck frame or of the locomotive type, is available, it is generally used. The use of a locomotive crane obviously saves unloading at some distant point and loading on trucks for transportation to the job. Instead, material is delivered in cars as loaded at the fabricating plant and is unloaded directly from them to a point on the ground near the position called for on the plans, or in some cases is lifted directly from the cars to its place in the structure. To offset the saving in hauling, handling, and possibly speedier erection, the high cost of transporting such a locomotive crane to the site must be carefully considered.

Truck cranes are of course limited in capacity and reach. Their capacity is generally from 5 to 10 tons, with main booms of from 35 to 45 ft. Jibs and jib extensions may be added to provide lengths of from 50 to 70 ft, the capacity being materially reduced by such additional lengths of boom. However, truck cranes are mobile and can be driven from job to job without the use of special trailers such as are needed for the heavier caterpillar cranes. Truck cranes are also frequently used in connection with the starting and completion of a guy-derrick job, and are ideal for quickly unloading the derrick sections and rigging, assembling the mast and boom, and tripping the mast, which then in turn sets the boom into position. If the mast is too heavy for the truck crane to handle from the edge of the excavation (or the nearest point to which it can be driven), the crane is generally used to trip up the boom, which in turn can be employed as a pole to set the mast in position. Similarly, truck cranes will expedite the loading out of a guy derrick and its rigging upon completion of the work, and will enable a small force of men to unload and set up an ordinary guy derrick, ready for work, in eight to ten hours.

In erecting mill and other low buildings, a different type of problem must be solved. The steel must be so divided that it can be unloaded near its final position, thus avoiding the necessity for moving it great distances from one part of the building to another. A construction road must generally be provided. If the foundation is satisfactory for crawler-crane operation, no surfacing may be required. However it is often necessary to lay a corduroy road. This may involve 3 by 12-in. or 4 by 12-in. planks laid transversely, or heavier timbers laid longitudinally under the two treads of the crane or the wheels of the delivering truck.



SMALL, LIGHT BUILDINGS CAN SOMETIMES BE ERECTED BY USE OF A "DUTCHMAN"

Again, the owner will often require work to be started at one end of a building before foundations have been completed at the other. Such factors as these must be taken into consideration and decisions made accordingly, for when the job is ready to start, the mill must have a shipping schedule based on probable erection, which in turn depends not only on the speed of the erectors, but on the probable dates on which the various foundations or sections of the building will be ready. Here, as well as in the schedule for the tier building, estimates must take into account probable delays in the erection schedule on account of bad weather. Often a shop must have a complete shipping schedule long before the job is even started, so that it is imperative that erection speed be well calculated, and that a satisfactory contact be made with the foundation contractor to insure that the site will be ready on time.

All of the innumerable and often seemingly unimportant details must be thoroughly investigated and properly weighed as to their effect on the progress of the work, for a satisfactory erection job depends almost as much on smooth planning in advance and on anticipating and taking care of all the loose ends beforehand, as it does on the skill of the men actually erecting the structure in the field.

Aluminum—How and Why

*The Development and Commercial Production of a New Construction Materia*ı

By Francis C. Frary

Director, Aluminum Research Laboratories, New Kensington, Pa.

AMONG the newest of the materials of construction are aluminum and its strong heat-treated alloys. Practical means for the reduction of aluminum go back only to 1886, extremely large electric currents being essential for its production. The pure metal is relatively soft and weak, although very ductile, and it must either be alloyed with other metals (principally copper and silicon) or cold worked, or both, to give the strength and hardness requisite for general use. The process yielding the "strong" heat-treated wrought alloys of aluminum so widely used today was developed even more recently (1906) by a little-known German chemist named Alfred Wilm, who was to devote an additional eight years to seeking a producer and mastering the technique before attaining commercial success. Since that time the good forming properties of aluminum alloys, plus their light weight (only about one-third that of steel), have opened to them an extensive structural field. These and many other facts about this comparatively new material are presented in the accompanying interesting paper by Dr. Frary.

ALUMINUM and iron, the two metals which occur most abundantly on the earth's surface, resemble each other in one important particular. Although they are so widely distributed as to be constituents of substantially all the earth's crust, it is economically satisfactory to extract them only from the more or less hydrated high-grade oxides that nature has fortunately laid down.

In the case of aluminum, which is nearly twice as abundant as iron in nature, we have a few instances of magmatic segregation with resulting deposition of corundum, but the mechanism of the concentration by water is the reverse of that which occurs in the case of iron. Thus, the bauxites (hydrated aluminum oxide ores carrying about 60 per cent alumina) appear to be generally the undissolved residues from the leaching of certain types of rocks, where the water has dissolved and carried away the lime, alkalies, most of the silica, and some of the iron oxide.

So long as there are adequate supplies of these naturally concentrated rich ores, we can hardly afford to treat the leaner ores, such as the clays, even though they are extremely abundant and easily obtained. The world's present known supply of bauxite is estimated to be sufficient to last, at the present rate of consumption, for at least a thousand years. Even after the bauxite is gone, there will still remain greater deposits of material which just escape classification as bauxite by reason of a somewhat higher silica content (for example, perhaps 10 to 20 per cent as compared with 5 per cent or less), and which could easily be worked at a slightly higher expense. Much of the soil of some tropical countries, such as India, is included in the latter category.

As a corollary to the condition that intensive weathering is required for their production, the known bauxite deposits are principally located in parts of the world having a tropical or subtropical climate. In the United States, the principal deposits are in Arkansas, with smaller amounts in Mississippi, Alabama, Georgia, and Tennessee. Other deposits occur in the northern part of South America, along the shores of the Mediterranean, in India, and in the Dutch East Indies. Undoubtedly many other such deposits will be discovered as tropical exploration proceeds and will be used sooner or later, when and if suitable transportation facilities place them in a competitive position.

Open-Pit Mining of Bauxite, the Ore of Aluminum

ALUMINUM ORE DIFFICULT TO REDUCE

If aluminum oxide is heated with carbon in the form of charcoal, coke, or similar substances, the impurities (iron oxide, silica, titanium oxide, and the like) are reduced to the metallic state, while the aluminum oxide remains as molten slag—the reverse of the situation in the case of iron. It was only after men learned to produce cheaply and to control immense quantities of electrical energy that it became possible to produce aluminum cheaply, although relatively expensive chemical methods of producing it had become available shortly before.

Since the impurities are reduced more readily than the aluminum oxide, it is clear that if pure aluminum is desired, all the impurities must be removed from the oxide before an attempt is made to reduce it. Because of the intimate manner in which these impurities are mixed and combined with the aluminum oxide, mechanical methods of separation are entirely inadequate for the purpose, and the relatively expensive processes of chemical purification must be resorted to. Fortunately, aluminum forms soluble compounds with the alkalies, while iron and titanium do not. Although silica also forms such soluble compounds, the latter are converted into insoluble ones by proper treatment in the presence of alumina.

The obvious way to separate the aluminum oxide from associated impurities is to get it into solution as sodium aluminate, leaving the iron and titanium undissolved as oxides, and converting the silica into insoluble sodium aluminum silicate. This may be accomplished in two ways—by calcining and leaching a mixture of soda ash

and bauxite, or by digesting the pulverized bauxite with a strong solution of caustic soda. In either case, a simple filtration of the resulting sodium aluminate solution eliminates substantially all the impurities.

A STEP IN THE CHEMICAL TREATMENT OF BAUXITE
Sodium Aluminate Liquor from Filter Presses Entering Precipitator

If we then proceed to neutralize the caustic soda in this solution with carbon dioxide (from lime-kiln gases, for example), the hydrated aluminum oxide is precipitated in a sandy crystalline form. The sodium carbonate can, of course, be recovered by evaporation and reused. But in case the alumina is being dissolved by digestion of the bauxite with a solution of caustic soda at elevated temperatures and pressures, we naturally do not want to convert this caustic into the much less valuable carbonate. However, by gradually cooling (after filtration) the strong aluminate solution produced by digestion, at the same time agitating it with some previously produced crystalline hydrated alumina, about two-thirds of the dissolved alumina will gradually precipitate in the desired sandy form. After separating this precipitate, the caustic solution can be used again for another digestion cycle.

In order to get rid of the water (which would cause disturbances in the electrolytic reduction operation following), the hydrated oxide is calcined in rotary kilns at about 2,400 F. Naturally, if high-purity aluminum is to be produced, care must be taken in this calcination to avoid contamination by fuel ash or by dust or fragments of the kiln lining.

Attempts to reduce the resulting pure alumina directly by smelting it with carbon will not produce the metal, because the temperatures required are so high that the aluminum comes off as a vapor which is carried off with the carbon monoxide. Moreover, this vapor cannot be condensed as a metal by cooling, because the reaction reverses at lower temperatures and the aluminum is again oxidized. It thus becomes necessary to apply some form of energy to the aluminum oxide at a lower temperature, under conditions which will allow us to separate the oxygen from the metal.

ELEMENTS OF THE ELECTROLYTIC PROCESS

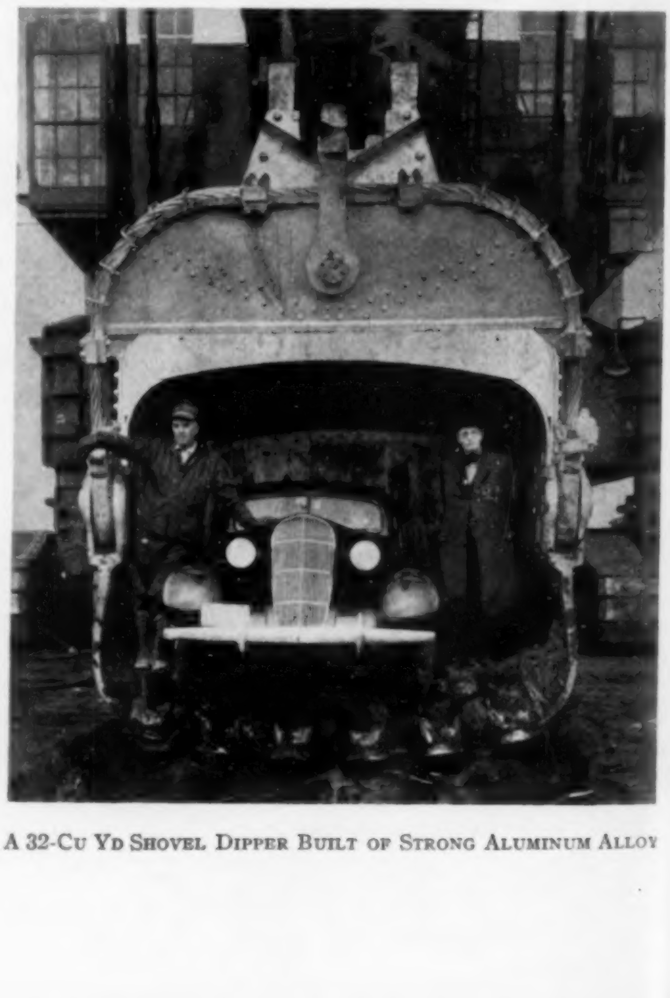
The practical solution of this problem involves dissolving the aluminum oxide in molten cryolite (sodium aluminum fluoride) and electrolyzing it with direct current at a temperature of about 1800 F. This is the process which Charles M. Hall and Paul L. T. Heroult invented independently, probably within a few weeks of each other, early in 1886. In essence, the process used today is substantially as they invented it, although, of course, many improvements have been made in the equipment and in the details of the process.

Molten cryolite is an extremely active and effective flux, attacking practically all minerals and metals (including steel). A carbon-lined steel shell was soon discovered to be a satisfactory container for this molten electrolyte, and nothing better has yet been found. The molten aluminum which we desire to produce is fortunately slightly heavier than molten cryolite, so that the carbon lining may be used as the cathode. Carbon is also used for the anodes, and here the electric current evolves oxygen from the aluminum oxide. Since the anodes are consumed by this oxygen, forming both carbon dioxide and carbon monoxide, any metals that are present in the ash of the electrodes will be dissolved by the cryolite and reduced by the current, contaminating the aluminum.

Since 1,000 amperes produce only about 14 lb of aluminum per day, it is evident that, in order to keep the cost down to a reasonable figure, the amperage employed on such cells must be very large—in practice, it varies between about 8,000 and 50,000 amperes. Even the largest of these cells produce less than 1,000 lb of aluminum per day, as compared with the 1,000 tons or more of iron produced per day in a modern blast furnace.

It is obvious that heat must be supplied to maintain such cells at the relatively high temperature of 1800 F. Fortunately the molten cryolite forms a solid crust on the top of the bath, and the insulating properties of this crust are decidedly improved by covering it with a layer of the alumina to be reduced, which is thus preheated before being introduced into the molten bath. For obvious reasons, external heating of such cells would be very undesirable, and would involve numerous practical difficulties as well. Fortunately, the electrical resistance of the cell and its contents is sufficient so that, if the cell is properly designed and insulated, enough heat will be developed to maintain correct operating temperature.

All this takes power, however, and since the total



A 32-CU YD SHOVEL DIPPER BUILT OF STRONG ALUMINUM ALLOY

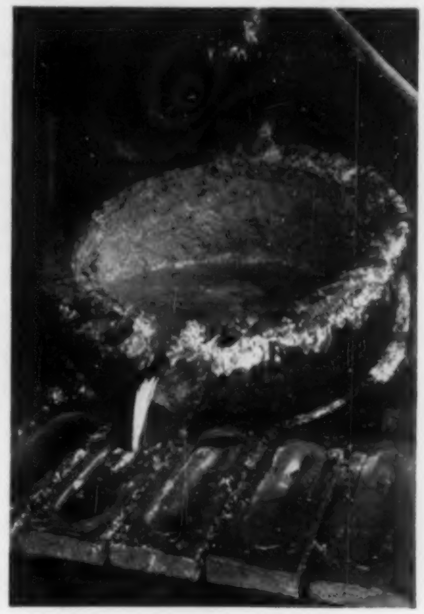
power consumption of a reduction plant will be nearly 12 kw-hr per lb of aluminum, power is a relatively large item in the cost. For this reason, aluminum-reduction plants are located where cheap electric power—generally from hydroelectric plants—may be obtained in large quantities. Since such locations are usually not very near existing cities or towns, aluminum producers are frequently faced with the necessity of building not only their own hydroelectric and reduction plants, but also towns for their employees.

Many interesting structural and electrical problems are involved in a reduction plant. Only about two volts is required, theoretically, to decompose alumina, and the actual voltage applied to a cell is only about five volts.

Therefore, in order to produce and distribute the required large amounts of electric power efficiently, a great number of these cells must be connected in series. In practice, each circuit comprises a hundred or more such cells, housed in one or two large buildings. These are connected in series by means of a bus bar system and are insulated from the ground and from each other. Electro-osmosis causes the development of tremendous pressures inside the steel shell, which is gradually distorted and often burst by such pressures. How to establish and maintain the contacts between the bus system and each of the steel shells and anodes, so as to reduce to a minimum the electrical losses at such contacts, is a very serious problem. The situation is further complicated by the necessity for ventilation for the removal of heat, fumes, and dust, and by other mechanical problems.

The resulting aluminum is relatively soft and weak, although very ductile, and in order to obtain the strength and hardness required for most commercial uses, it must either be alloyed with other metals or cold worked, or both, and some of the alloys may also be heat-treated. The principal alloying elements used are copper and silicon. Commercial casting alloys commonly used in this country, for example, often contain between 4 and 8 per cent of copper, or between 5 and 12 per cent of silicon. The important high-strength wrought alloys most commonly employed contain about 4 per cent of copper. Of the metals used in smaller amounts, magnesium, manganese, and iron are the most common, although small amounts of others, such as nickel, zinc, chromium, and lead are sometimes used.

Aluminum castings are usually made from alloys, because pure aluminum is not only weak and soft in the cast state, but is also not easily cast satisfactorily in the foundry. Formerly alloys containing about 8 per cent of copper were used for practically all the commercial aluminum castings. Increasing amounts of aluminum-silicon alloys have recently been used, particularly for architectural purposes and for die castings; and heat-treated aluminum-base alloys containing about 4 per cent of copper have been employed to a large extent in the form of sand castings where higher strength and ductility were required than the 8 per cent copper alloy could give.



POURING ALUMINUM PIGS IN A REDUCTION PLANT

Aluminum-Reduction Plants Require Large Quantities of Electric Power

One of the outstanding properties of aluminum is its ductility. This permits it to be wrought into a large variety of articles by such hot or cold work as rolling, forging, spinning, extrusion, and the like. In particular, the combination of low strength and high ductility at elevated temperatures makes it possible to satisfactorily extrude not only pure aluminum but also aluminum alloys in a great variety of shapes. The fact that long pieces of complicated cross-section can thus be produced at relatively low cost has been of considerable importance to structural engineers, because such special shapes have been found advantageous in the construction of such structures as railway cars, street cars, and buses. A single extruded shape in aluminum will often accomplish several purposes at the same time, where the use of most other metals would require a structure to be built up by the riveting or welding of several pieces.

The simplest and cheapest means of improving the strength and hardness of wrought articles of pure aluminum is, of course, the use of a certain amount of cold work, such as rolling, hammering, and wire drawing. By this means, similar effects can also be obtained on wrought-aluminum alloys containing moderate to small amounts of alloying ingredients. Such wrought products are commercially produced in one-quarter hard, one-half hard, three-quarters hard, and full-hard tempers. Also, customers frequently obtain sheet material in the annealed condition, and harden and strengthen it by their own fabricating processes; as, for example, in the drawing and spinning of utensils. The ultimate strength

ALUMINUM AS USED IN THE MARSHALL FIELD STORE, CHICAGO

MANY HIGH-VOLTAGE LINES EMPLOY STEEL-REINFORCED ALUMINUM CABLE

of the hard-wrought temper of pure aluminum may be 80 per cent higher than the annealed state, while the yield strength may be increased by several hundred per cent with, of course, a corresponding reduction in ductility.

The heat-treated strong wrought alloys of aluminum are probably the most interesting group at present. They furnish structural material for use in aviation, and compete with other metals in many diversified fields. Their present development is a recent one, and their history interesting.

In 1901, a little-known German chemist named Alfred Wilm left the employ of the Goldschmidt Company (where he had been working on the development of thermit welding) to do research on metals in a government laboratory near Berlin. Most of the problems were of a military nature, and one of those assigned to him was the development of an aluminum-base alloy which should resemble brass sufficiently in its physical properties so that it could be satisfactorily drawn into cartridge shells.

After some years of experimentation, he discovered that certain aluminum-copper alloys could be given materially improved physical properties (strength and ductility) by heat treatment at a definite temperature followed by quenching in water. But since the strengths obtained were still insufficient for his purpose, he tried adding other alloying ingredients. In 1906, he discovered that the addition of 0.5 per cent magnesium caused an additional change in properties, which took place at room temperature on a few days' storage after the heat treatment, and resulted in a very decided increase in tensile strength without any reduction in ductility.

After two years more of hard work directed towards the development of the exact composition that would give the best results, and just as Wilm was ready to have this alloy tried out commercially by the munitions company which was cooperating in the investigation, a change was made in the directorship of the metallurgical division of the laboratory. The new director could see nothing of value in the work, and as a result, Wilm left the laboratory. The authorities were not interested in his invention, and he finally got patent rights to it and tried to get it produced commercially by the Dürener Metallwerke.

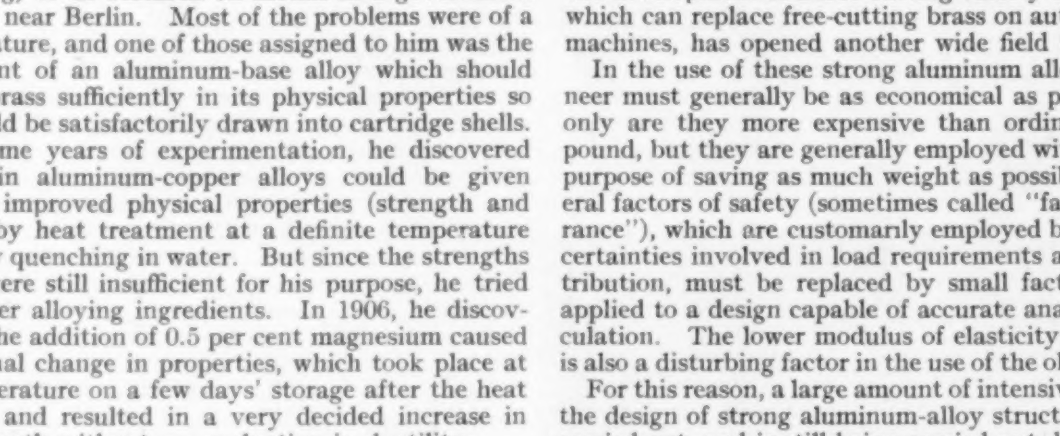
The technique of the production and heat treatment of this alloy were so difficult to master, and the results so irregular, that (it is said) the producers later wanted to give up in despair, but were prevented from so doing by the insistence of the chief engineer of the Zeppelin Company, who had a vision of the value of such alloy sheet to his company. The alloy was eventually produced commercially in Germany just a little before the beginning of the World War.

When the Zeppelins were found to be successful, other countries naturally investigated this new alloy and succeeded in producing it before the end of the War. However, the greatest development has been carried out since the war, through intensive study and plant tests, until now this alloy is one of the most uniform and reliable materials available to the engineer, as far as physical properties are concerned.

In addition to the original "duralumin" (the name adopted by the Dürener Metallwerke for their product), there are now a number of other heat-treated alloys yielding a range of tensile strengths from 35,000 to 70,000 lb per sq in. with suitable elongations. Having fairly good forming properties and a weight only about one-third that of steel, these have opened up new and extensive structural uses for aluminum, wherever the saving in weight of the structure is of sufficient importance to justify their cost. Not only airplanes, but truck bodies, railroad trains, crane booms, bridge floors, and other structures have been lightened by their use, and the development of a free-cutting variety of these alloys, which can replace free-cutting brass on automatic screw machines, has opened another wide field to aluminum.

In the use of these strong aluminum alloys, the engineer must generally be as economical as possible. Not only are they more expensive than ordinary steel per pound, but they are generally employed with the express purpose of saving as much weight as possible. The liberal factors of safety (sometimes called "factors of ignorance"), which are customarily employed because of uncertainties involved in load requirements and stress distribution, must be replaced by small factors of safety applied to a design capable of accurate analysis and calculation. The lower modulus of elasticity of aluminum is also a disturbing factor in the use of the older formulas.

For this reason, a large amount of intensive research on the design of strong aluminum-alloy structures has been carried out, and is still being carried out, both here and abroad. Some of the results have already been published, in the October 1936 PROCEEDINGS of the Society and elsewhere, and much of the information obtained has a bearing on the design of structures in steel as well as in light metals. Increasing competition from the strong light-metal alloys, and increasing knowledge of structural design which will be brought about thereby, will in time react beneficially upon the design of steel structures, and hence upon our knowledge of structures in general, to the advantage of both the structural engineer and his clients.



ALUMINUM AND ALUMINUM ALLOYS ARE EXTENSIVELY USED IN THE CONSTRUCTION OF STREAMLINED TRAINS

The Work of the U. S. Lake Survey

Preparing Navigation Charts for the Greatest Inland Waterway in the World

By C. R. Pettis

Member American Society of Civil Engineers

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Few surveying organizations have a wider field of activity than the Lake Survey, whose charts insure the safety of water-borne commerce from Duluth to the St. Lawrence. Triangulation, soundings, discharge measurements, precise leveling, and topographic work are all a part of the routine field operations. In the office, a set of 128 charts is under constant revision; and detailed hydraulic and hydrologic studies are always under way. Colonel Pettis here tells an interesting story of the Lake Survey's problems and achievements since it was created in 1841, and his frequent references to the work of individuals reflects the esprit de corps of the organization.

The primary function of the U. S. Lake Survey is making charts of the Great Lakes, and in this capacity it is closely associated with navigation on the Lakes. As early as 1816, navigation was becoming of sufficient importance to justify the War Department in making a number of local surveys, and in 1840 a survey for a ship canal around the falls at Sault Ste. Marie was made by officers of the Topographical Engineers. At this time the only charts of the Great Lakes were the British Admiralty charts, which were of limited use in this country, as they showed but little detail of the United States shore.

The Lake Survey came into being in 1841 when Congress made an appropriation of $15,000, for the double purpose of furnishing reliable charts to lake vessels and of determining from surveys the works of improvement which were necessary to the prosperity of lake commerce. At this time the channels of the St. Clair River were circuitous and narrow, and so obstructed by sand bars where they entered Lake St. Clair that vessels in low-water seasons frequently were compelled to have their cargoes taken over the bars in lighters. A few men of vision were looking forward to the day when vessels drawing 12 ft could freely navigate the Great Lakes.

The War Department has now spent about $250,000,000 on the harbors and connecting channels of the Great Lakes, and the present project calls for a depth of 24 ft in all the principal harbors and channels. The work of the Lake Survey has increased in importance and complexity, and it now costs about $200,000 a year to produce charts for navigators, and to furnish the War Department with the hydraulic information that is necessary for planning purposes.

The U. S. Lake Survey Office surveys and charts, for navigation purposes, the Great Lakes and connecting streams as far down the St. Lawrence River as the international boundary at St. Regis, 66 miles above Montreal. This work is confined to United States territory, except for the depiction of such Canadian waters and shores as may be essential to the usefulness of charts showing whole lakes or connecting rivers. Surveying and charting of Canadian waters is conducted by the Hydrographic Service of Canada, Department of Mines and Resources, Ottawa, Ontario.

In addition, the Lake Survey publishes charts of Lake Champlain and of the navigable waters of the New York State Barge Canal. It is also charged with the preparation of charts of the Lake of the Woods and other boundary and connecting waters between that lake and Lake Superior.

The production of suitable charts requires, first, accurate and painstaking work in the field; second, conscientious application of this field work to office maps and records; and third, the transfer of these office maps to the plates from which the charts are printed.

The surveys must cover not only the inshore waters and the open lakes, but a strip along the shore as well, so as to provide landmarks for navigators. This strip generally extends about half a mile back from the water. The field work must be carried on by engineers who are carefully trained in hydrographic surveying.

A primary triangulation net covering the Great Lakes was established by the Lake Survey Office between 1865 and 1875. It has since been supplemented by other primary surveys, the last one of which was made in 1932. This work now forms a part of the primary triangulation net covering the United States. To make it useful for hydrographic work, secondary nets have been established along the shore lines of the Lakes.

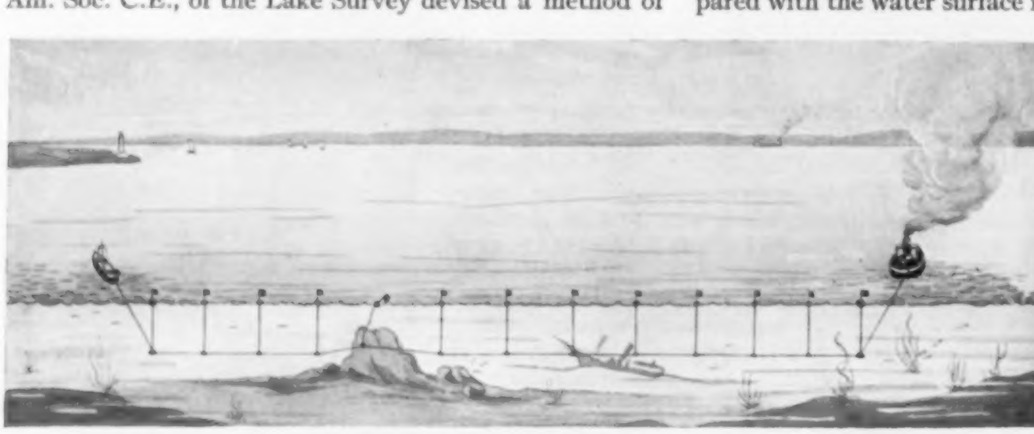
Between 1860 and 1875, waters were sounded with the lead line from the shore out to a depth of about 22 ft. Now that boats of greater draft are in use, inshore sounding is carried to a depth of 30 ft. Such sounding must be repeated frequently in order to note changes in depth caused by dredging or shoaling.

Beginning in 1860, occasional soundings were made in the open lakes to obtain general lake depths. The work was done with the lead line, and extensive surveys of this nature would have been very expensive. In 1928, the office purchased a fathometer, or echo sounding device, which makes it possible to obtain fairly accurate soundings rapidly; and in the next four years soundings were made on all the Lakes on lines three miles apart. At the same time, 28,000 determinations were made of magnetic declination, by comparing the readings of a magnetic compass and a gyro compass. This work was done by H. F. Johnson, who is still with the office. The fathometer located one shoal of 22 ft in Lake Superior, in water which was previously thought to be several hundred feet deep.

Sounding Machine on the Steamer *Peary*, Showing the Depth Indicator and Deflection Angle Indicator

The customary method of locating

shoals in suspected areas is to use a sweep. An iron bar 100 ft long, suspended at a given depth below a vessel, makes an effective sweep. In 1902, F. C. Shenehon, M. Am. Soc. C.E., of the Lake Survey devised a method of sweeping with a wire suspended at a given depth by floats, and towed by a vessel at each end of the wire. This greatly extended the scope and speed of sweeping operations, as a path 3,000 ft wide can be easily swept at one operation. Sweeping is the most effective method of locating wrecks, and in one case use was made of a sweep about three miles long. The wire sweep is now in general use throughout the world.



THE WIRE SWEEP IN OPERATION
This Device Was Developed and First Used by the Lake Survey

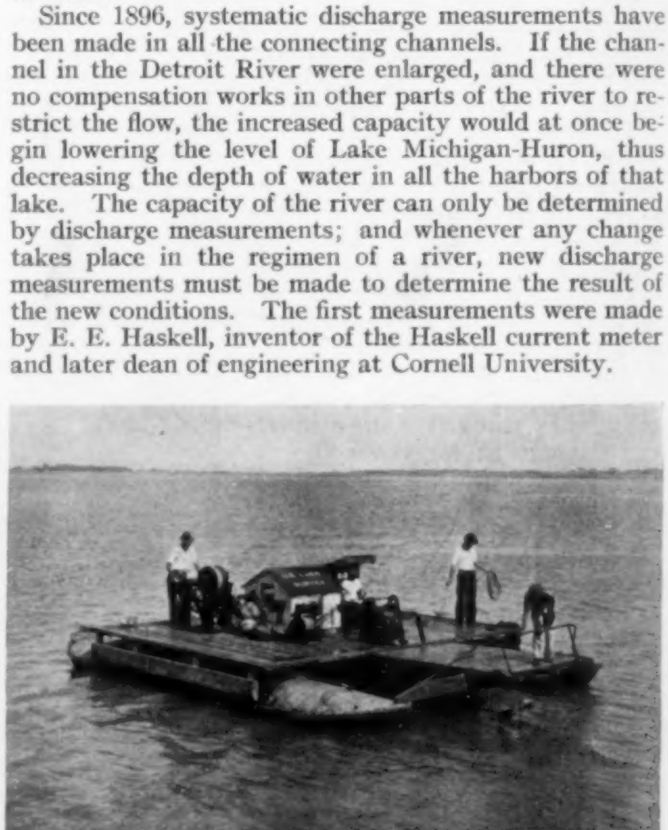
The Lake Survey publishes 128 charts; the program of revision calls for new editions of most of the charts every three years, but some of the general charts are revised only every five years. For any important change affecting navigation, corrections are at once made by hand on all charts in stock. The organization includes not only the engineering section and drafting room, but a well-equipped and up-to-date lithographing and printing section. A high standard of typography is maintained by S. L. Smith, who is in charge of this section. Last year more than thirty thousand charts were distributed. Each year the Lake Survey publishes a bulletin of about 500 pages to supplement the information given on the charts; and once a month during the navigation season a supplement is issued giving all changes of interest to mariners.

Occasional records of lake levels are available as far back as 1815, but it was not until 1859 that the Lake Survey established gages and began keeping accurate and continuous records of lake levels. At present there are 32 gages in operation on the five lakes and the connecting rivers from Duluth to the St. Lawrence. Most of them are automatic, and keep a continuous record winter and summer. Lake levels are computed each month for the information of navigators, for they may change sufficiently to affect the depth to which boats can be loaded with safety. In order that depths for navigation may be uniform, all channel dredging is based on datum planes which are established for each of the lakes.

Frequently it is desirable to carry a level line between two points on the same lake by means of a "water transfer." A gage is established at each point and read for several months. It is assumed that for the given period the two points are on the same water-level surface. While there will be frequent daily variations in level due to weather conditions, the foregoing assumption for a seven-month period should be true within 0.01 ft. In working with water transfers, Sherman Moore discovered that in the last forty or fifty years there have been certain progressive changes in relative levels. For example, in Lake Michigan the water surface in the upper end of the lake has been gradually sinking when compared with the water surface in the lower end of the lake, all measurements being made with reference to benchmarks on the land. The only explanation is that the land at the upper end of the lake is rising in comparison with that at the lower end. The movement would only amount to a few inches in a hundred years. Somewhat similar movements are taking place in the other lakes; the present indications are that they are somewhat irregular. (Mr. Moore is now engaged in making a more complete analysis of the movement as a whole, based on the latest information.)

In 1865, D. Farrand Henry of the Lake Survey made the first measurements of flow in the connecting rivers of the Great Lakes—the St. Marys, St. Clair, Detroit, Niagara, and St. Lawrence. Most of his measurements were made with floats, but while he was engaged on this work he developed the first electrical recording current meter. He used a cup meter, similar to the present Gurley type. It is interesting to note that some of Mr. Henry's measurements check within 4 per cent the results obtained by using modern instruments and modern methods.

Since 1896, systematic discharge measurements have been made in all the connecting channels. If the channel in the Detroit River were enlarged, and there were no compensation works in other parts of the river to restrict the flow, the increased capacity would at once begin lowering the level of Lake Michigan-Huron, thus decreasing the depth of water in all the harbors of that lake. The capacity of the river can only be determined by discharge measurements; and whenever any change takes place in the regimen of a river, new discharge measurements must be made to determine the result of the new conditions. The first measurements were made by E. E. Haskell, inventor of the Haskell current meter and later dean of engineering at Cornell University.



THE CATAMARAN FROM WHICH THE HYDRAULIC PARTY CONDUCTS THE RIVER DISCHARGE MEASUREMENTS

The method employed by the Lake Survey in measuring the flow of the rivers is based on the theory that if the velocity at any point in the cross-section increases, the velocity at all other points will increase by the same percentage. It has been demonstrated by repeated observation that this relationship holds true for such changes in stage and velocity as are encountered on the connecting rivers, which are much more uniform in both stage and velocity than most natural rivers.

A Precise Level Party Carrying a Line Through the Niagara River Gorge

Cross-sections for discharge measurements are selected carefully and preferably in reaches where the flow is uniform. The cross-section is divided into a number of panels—perhaps 20, in a wide river. In each panel simultaneous readings are made on two meters; one of them is held at the "index point" (a central point at about 0.4 of the depth below the surface) and the other is successively placed at each tenth of depth below the surface. From these readings, of which some 15 sets are made, both vertical and transverse velocity curves for the entire cross-section are computed. As a matter of convenience all velocities are reduced to percentages of velocities at the index points. The final field work consists of taking about 20 sets of readings at the index points. Then, by applying the velocity distribution data to these readings, the velocity at every point in the cross-section can be obtained and the river discharge computed. This method, which is very accurate both theoretically and practically, was derived by Mr. Shenehon, already mentioned as the inventor of the wire sweep.

From several such measurements at various gage heights, an equation is determined expressing the law of flow. Where there is a definite control point acting essentially as a free overfall weir, the flow may be related to a single gage, and the equation takes the form, $Q = K(H - Y)^n$, in which Q is the discharge, K a constant, H the gage height, and Y a constant, so that $(H - Y)$ represents theoretically the depth over the weir. In the Detroit and St. Clair rivers, however, there is a backwater effect from Lake Erie, and the discharge formula must take into account the fall between two gages. The proper exponent for this additional term is determined from the observations. Equations are determined for each gage or combination of gages on the river, and the flow is computed by each equation each month. In this way any error in the gages, or any change in the capacity of the river, is at once detected.

A Final Step in Preparing a Chart—Pantograph Operator Engraving Lettering on Photographic Negative

Under the direction of the Division Engineer, the Lake Survey makes studies of any hydraulic problems which may arise, giving particular attention to the effect upon lake levels of any changes in the regimen of connecting rivers which may be made by navigation improvements or otherwise.

One of the studies assigned this office in 1936 was the preparation of a rule curve for the regulation of Lake Superior. This study involved both hydraulics and hydrology; and it was also necessary to consider the navigation, power, municipal, and international interests, all of which are concerned with the flow of water at the Soo. The flow can be completely regulated by means of gates and the power plants, and consideration must be given to the seasonal variation in the level of the lake. Under regulation, high water is not allowed to go above that which would have obtained in a state of nature, and low water is limited to an arbitrarily fixed minimum.

HYDROLOGY OF THE LAKES STUDIED

About 1900, Thomas Russell of the Lake Survey made a study of the hydrology of the Great Lakes. He had a correct theoretical conception of the problem, but the results were unsatisfactory, mainly because he had practically no data about the flow of rivers. Later studies of hydrology were made both in the Lake Survey Office and by civilian engineers, but for various reasons none of the results were satisfactory. In January 1936 the Lake Survey established four evaporation stations, at Duluth, Kewaunee, Detroit, and Buffalo, and an effort is made to keep the water in the pans at the same temperature as that in the lakes. With the information thus obtained it is believed that a clear and definite conception will be obtained of the relation between rainfall and lake levels. The evidence at the present time indicates that the underground flow into the lakes is of the same magnitude as the surface flow of the streams; and that evaporation from the surface of the lakes is considerably more than has been previously estimated.

The Great Lakes have been the subject of engineering investigation for a little over one hundred years. In meeting its problems, the Lake Survey has had to devise new methods and increase its standards for accuracy, as the Great Lakes have gradually become the most important commercial inland waterway in the world. The spirit of the Lake Survey is typified by the present principal assistant engineer, Sherman Moore, who has been with the office for 35 years. Mr. Moore has done original work in hydraulics and in land movements in the area; and he is passing on his knowledge and experience to the younger engineers who will have to carry on the traditions of the organization.

Engineering Pioneering Since John Smeaton

Leading Developments in the Field of Civil Engineering from 1750 to 1900

By Richard Shelton Kirby

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It is perhaps difficult for the modern civil engineer to visualize what conditions in the profession must have been like in 1750, when the field was largely unexplored and engineering works were "at once inventions and adventures." By 1800, however, the work of the three great English experimenters—Smeaton, Watt, and Cort—had laid the practical foundations that served as a basis for the technical triumphs which followed. These developments may be adequately traced in the achievements of the three generations of engineers of the nineteenth century. The first was responsible for cast-iron arch and wrought-iron suspension bridges, canals, crushed-stone roads, and steam railroads. The second generation produced early water-supply systems, truss bridges, and paved city streets; and the third, machinery and power development, applications of steel and reinforced concrete, and sanitation. This article, while complete in itself, forms a logical conclusion to Professor Kirby's review of engineering highlights, begun in "Civil Engineering" for November 1937, under the title, "Some Engineering Beginnings."

By the middle of the eighteenth century, the profession of engineering had begun to demand and to receive, in France at least, official recognition. The engineer had his mathematics, his mechanics and hydraulics, and all the chemistry he needed at the moment. He was therefore less and less obliged to lean on intuition; and, especially in England, there was a rising tide of interest in experimentation, with practical ends in view.

Just after 1750 three British experimenters were busy in different fields. All three were contemporaries of George Washington and of George III, and what they accomplished was destined immediately and profoundly to affect engineering. The engineers who came after them not only employed different tools, materials, and methods of work, but began to approach their problems in a more scientific spirit—in a word they became gradually less empirical and less easily satisfied with rule-of-thumb design and the blind following of precedent.

John Smeaton, F.R.S., a practical scholar, was the first man to realize that he was a "civil engineer" and to so subscribe himself (simply to emphasize the fact that he did not serve in the army or navy). His erection of the Edystone Lighthouse, 1757–1759, while a brilliant achievement, was altogether secondary to his less spectacular but much more important scientific investigations in a number of fields, especially in hydrostatics and in connection with the problem of hydraulicity of limes—the reasons why some limes would harden under water and others would not. His name and fame gave needed prestige to the new profession. Smeaton contributed many papers to the Royal Society, and his professional reports served as the first civil engineering textbooks in English.

John Smeaton, F.R.S., the First Man to Subscribe Himself a Civil Engineer

Edystone Lighthouse, Erected in 1757–1759, Appears at the Left

The second man was James Watt, friend of Smeaton and himself at one time a civil engineer planning Scottish canals and water works, but properly immortalized for his perfecting of the Newcomen steam engine, without which one can hardly imagine any modern engineering.

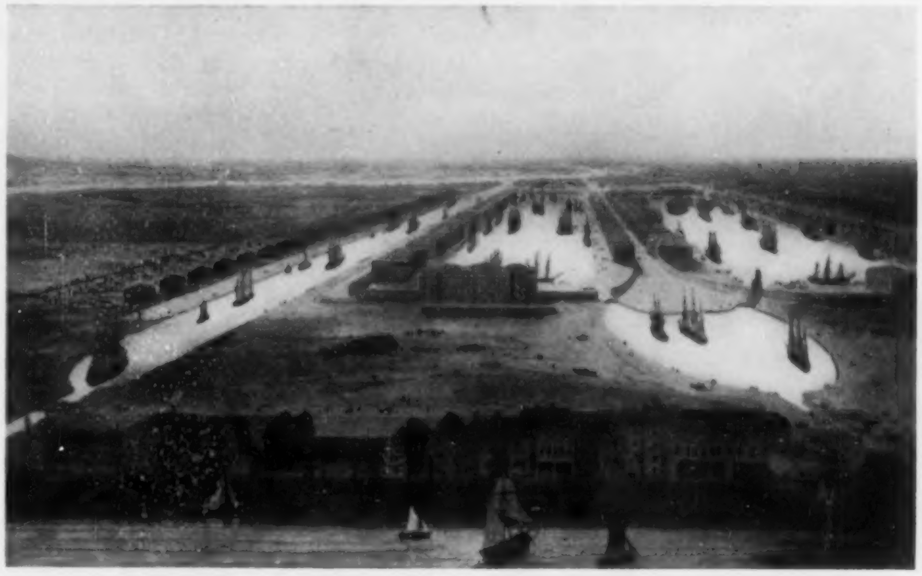
Not so well known is the third of the trio, Henry Cort, who has been called the English Tubal Cain. His invention of grooved rolls in 1783 made modern rolling mills possible, and his puddling process contributed enormously towards simplifying the production of wrought-iron on a large scale. The influence of these three men extended far beyond their respective lifetimes, and in the course of a few decades changed the outlook of the entire engineering profession.

Three Generations of Engineering Achievement in the Nineteenth Century

It will be convenient, although not strictly accurate, to divide the remainder of our review into three parts, corresponding roughly to the three generations of the nineteenth century. However, for a full understanding of the first generation's work, especially in the field of bridges, we must first retrace our steps a few years into the eighteenth century.

The majority of medieval European stone bridges apparently represented attempts to reproduce the Roman style, while nearly all the others seem to have been designed by architects whose forte was Gothic cathedrals. No entirely new type was developed until well along in the eighteenth century, in the days of the French engineer Perronet, who revolutionized practice in bridge building. This great leader of the French school broke away from massive abutment-like piers and semicircular arches, and gave us stone bridges that for beauty and refinement of line have never been surpassed. Two of his masterpieces are in Paris. Louis XV and his brilliant court went down to Neuilly to see the timber centers of the first one removed, half fearing that the whole bridge would collapse and drop into the Seine—but it still stands. The other, the Pont de la Concorde in the center of Paris, was Perronet's last work, finished partly

with stones from the Bastille, in the master's old age just as the French Revolution broke out. It also is as good as ever, but it has lately been skillfully, even reverently, widened. While almost no American stone bridges date from this period and none is in any sense monumental, I cannot forbear mentioning the one which, I believe, still carries the Lincoln Highway over a creek near Lancaster, Pa. This structure is a monument to the marital felicity of its creators, for the tablet still reads, "Built in 1800 by Abraham Witmer and his wife."



West India Docks, London, Constructed for the West India Trade in 1800–1802
From an Early Engraving by William Daniell. The Larger of the Two Basins Is 2,600 Ft Long

THE FIRST GENERATION BUILDS BRIDGES OF NEW TYPES

Late in the eighteenth century, iron moulding on a large scale had been worked out in England and Germany. As iron masters began to feel increasing confidence in their product, cast-iron was applied to larger and larger undertakings. Finally, in the years 1775–1779, during the American Revolution, Abraham Darby and his colleagues erected the world's first iron bridge, a cast-iron arch of nearly 100-ft span, near Coalbrookdale, on the Severn in west-central England. This bridge is almost as good as new, after having lasted longer than the Constitution of the United States (and with far less amending). In passing, one might note that some twenty years later Thomas Paine's eloquence failed to convince Philadelphians that the cast-iron bridge which he contrived should span the Schuylkill; metamorphosed, it eventually and until our day spanned the Wear in England.

Stone Bridge near Lancaster, Pa., "Built in 1800 by Abraham Witmer and His Wife"
From the Lancaster County Historical Society Papers

To engineers of the first generation of the nineteenth century belongs the credit for inception of the modern suspension bridge with its level floor—a type which only today is reaching its fullest development. Previously a suspension bridge had meant the bridge known to the Incas perhaps centuries before the Spaniards arrived in Peru—essentially a floor resting directly on two sagging flexible cords. The leader in this new development was a comparatively obscure "judge" of a frontier settlement in southwestern Pennsylvania, one James Finley, who built his first suspension bridge in 1801, using forged iron bars for the cables. The suspension type of bridge reached its early culmination in 1829 with Telford's great Menai Straits Bridge in Wales, which still carries fairly heavy motor traffic from the mainland across to the island of Anglesey.

In the United States most of the late eighteenth and early nineteenth century bridges were of wood, of the combination truss-and-arch type—covered bridges obviously similar to those built earlier by the Grubenmanns in Switzerland. Two or three New Englanders achieved reputations for their ability to span wide rivers with these bridges, sometimes facetiously called "coffins for sea serpents."

The first generation saw an enormous increase in foreign commerce, notably British. Very early in the century English engineers completed on the Thames below London several extensive dock systems, which look much the same even to this day, after having been subjected for more than a century to 25-ft tides. Newly invented dredges and other steam-operated devices made such construction possible.

THE ERA OF CANAL BUILDING

Except for Col. John Stevens of Hoboken and a few such rare spirits, Americans of the early nineteenth century believed that all important transportation was to be water-borne, and that the natural rivers must therefore be supplemented by countless canals. Robert Fulton, whom few visualize as an artist and canal designer, looked confidently forward to the day when little canals would wind through every valley in the land. In England, canal building, begun in the previous century, developed almost into a mania. In the United States, around 1800, several pioneer artificial waterways were built in widely scattered localities, including the Middlesex, Hadley Falls, and Santee canals. The culmination of such efforts in this country came of course in 1825 with the completion of the Erie Canal, a lasting monument to the genius of our almost untaught native engineers, headed by Benjamin Wright. It should be remembered that the canals which preceded the Erie were all built with wooden locks and that down through the 1840's at least, practically the only excavating machinery available was a husky laborer fresh from the Emerald Isle, who would

peg away good naturedly, up to his knees in mud, for a dollar a day.

Modern crushed-stone roads began in France in the eighteenth century. But the troublous years 1792–1815

THE LIVERPOOL AND MANCHESTER RAILWAY, BUILT BY GEORGE STEPHENSON, 1830
From C. F. Dendy Marshall's *Centennial History*

set France so far behind in her road building that, before she recovered, Great Britain forged ahead with her two Scottish engineers, McAdam and the much more versatile Telford. We have perhaps been inclined to overrate the former, largely, as someone has said, because his surname is so readily "macadamizable" into a verb.

EARLY RAILROADS IN ENGLAND AND AMERICA

The engineers of the first generation of the nineteenth century took the little private coal and iron roads of England and Wales, and from them, in thirty years' time, developed railroads comparable to those of today. Extending south from London along a valley in the neighborhood of the Croydon flying field of today, there was completed in 1803 the Surrey Iron Road (we should call it a freight horse railroad), the first ever built for the use of the public at large. Next, Watt's steam engine, somewhat improved, was connected to wheels by Richard Trevithick and put on a track in South Wales. The miners then had a noisy, shaky, and temperamental monster which could do the work of many horses. Next came the self-instructed engine mechanic, George Stephenson, who, after years of experimentation, tamed the monster. Stephenson built two railroads. The first, completed in 1825, was the comparatively crude Stockton and Darlington Railway in northeastern England—almost altogether a coal road; and the second, only five years later, was the much more finished Liverpool and Manchester, a road which probably attracted more world-wide attention than any built in the century following.

America's part in the early development of railroads began a trifle later than Great Britain's, but construction here was more hectic and daring and less substantial, in keeping with a newer country. Close on the heels of the Liverpool and Manchester Railway followed our own Baltimore and Ohio, whose engineers, pushing their road confidently westward across the Alleghenies, carved their names high on the list of the country's pioneers, as their successors did in the Far West a generation later.

IMPORTANT WATER WORKS BUILT BY SECOND GENERATION

Except for the water supplies of Paris and London, which boast some centuries of picturesque history, modern water-works systems were practically all outlined and begun by the second generation of engineers. One should not forget, however, the Fairmount Water Works at Philadelphia, completed in 1822, which Americans of the day (particularly, of course, Philadelphians) were fond of classing among the wonders of the world. The water wheels of its pumping system were run by the current of the Schuylkill, as had been the practice centuries earlier in Europe. Philadelphians were the first Americans to drink water conveyed through cast-iron pipes instead of bored logs (this was about 1804).

Conspicuous among the water-works systems of this second generation were three—all of them completed between 1840 and 1850. First came the Croton works to supply New York City, the earliest aqueduct of any

FAIRMOUNT WATER WORKS, PHILADELPHIA, COMPLETED IN 1822
Union Canal in the Foreground

length in the United States, and for its day, with the tall High Bridge over the Harlem River valley, no mean achievement. Its engineer, John Bloomfield Jervis, stands highest in point of actual all-round achievement among the civil engineers produced by America before the Civil War. Shortly thereafter Boston completed its first extensive water-supply system, drawing water from Lake Cochituate. But much more elaborate than either the New York or the Boston system was that at Marseilles, France, under construction at practically the same time, with its 51-mile aqueduct, passing through more than forty tunnels and over the wonderful Roquefavour Bridge 300 ft tall, a structure that in some respects has never been equaled since, and of course would not be built today.

AMERICANS DEVELOP TRUSS BRIDGES

Palladio's sixteenth-century idea of simple truss bridges with triangular panels lay dormant for 250 years or more, as has been the case so many times in history. In the main, the truss bridge has been an American development, largely by New Englanders. First among these was Ithiel Town, back in the first generation, a cultured architect-engineer of New Haven, Conn. His patent lattice truss, in wood and later in iron, was used widely, beginning in 1821, in the United States and abroad, and the canny inventor waxed prosperous on royalties. Next came Stephen Harriman Long, a U. S. Army engineer from New Hampshire and a graduate of Dartmouth College, who in 1830 patented the Jackson truss (named for President Jackson) and who also wrote the first American engineers' pocketbook. This truss was long popular on the early American railroads, but is now obsolete. In 1840 an ingenious master-carpenter developed the Howe truss, which is still used. Howe is said to have made his first working drawings to a very large scale on the walls of an old tavern in his home town, Spencer, Mass. It is a far cry from this to the modern

bridge-designer's office, with its higher mathematics and its exacting tolerances.

Better known to this generation of engineers is the still widely used Pratt truss, devised and patented in 1844 by Thomas Willis Pratt, a Boston railroad engineer associated with the inception of some of the roads later absorbed into the New Haven system.

Finally, after many hundreds of trusses (including the types we have noted and dozens of others), had been built in wood, iron, and in combinations of the two, a particularly gifted New England-born Union College graduate, Squire Whipple, published in 1847 the first book in any language in which the stresses in trusses were scientifically and correctly analyzed. Bridge design, as opposed to bridge carpentry, dates from Whipple and his contemporary, Herman Haupt.

Until a century ago most city thoroughfares were paved, if at all, in a fashion that today would not be tolerated in alleys. The second generation of nineteenth century civil engineers included men who gave us the first city pavements worthy of the name. Undoubtedly the smoothness of interurban travel on the new turnpike roads and the still newer railroads stimulated the desire in cities for something better than nerve-wracking cobblestones. Carefully fitted granite blocks in London are due in large part to the initiative of the great Telford, in his youth a stonemason. Wooden blocks, a novelty from Russia, were introduced in London about 1838, and came into some American cities, especially Chicago, some years afterward, while asphalt arrived still later from France.

At this time the crushed stone for all roads and pavements and for concrete the world over was broken by hand. Not until 1858, when Eli Whitney Blake of New Haven (nephew of Eli Whitney), invented the first successful stone crusher, was it possible to do this by machinery. The roads in Central Park, New York, then being built, were the first on which the new product was used.

THE THIRD GENERATION—IMPORTANT ADVANCES

In the third generation occurred the first offshoot from the parent profession—a group of engineers who began to specialize in the design and use of machinery and in power development, and who began to call themselves dynamical or mechanical engineers. Among their accomplishments one might briefly note the refinement of water wheels, especially turbines; the employment of steam at ever-mounting pressures; the applications of compressed air to the transmission of power; and the beginning of the development of the internal combustion engine. And one should not fail to remark that Eli Whitney's epoch-making invention, not of the cotton gin but of interchangeable parts in manufacturing, began to be widely appreciated only in this period, after decades of apparent neglect, and pointed the way towards the large-scale factory production of today.

Ithiel Town, Inventor of the Lattice Bridge Truss

The Glasgow (Mo.) Bridge, Completed in 1879, Was the First All-Steel Bridge to Be Built

Other basic engineering developments during this period fall perhaps into four well-defined groups—the use of steel, reinforced concrete, tunneling, and sanitary engineering.

STEEL ENTERS THE PICTURE

Modern steel development, at least in its earliest and most significant phases, centers roughly about the period of our American Civil War, but the scene was laid mainly on the other side of the Atlantic. Just before 1860, Henry Bessemer, an ingenious young English inventor, in attempting to make stronger iron cannon, showed the world how to make steel successfully in large quantities. Excepting perhaps Eli Whitney's invention, the Bessemer process was the invention most important to the engineer since Watt's steam engine. His process was almost immediately applied to steel rails, which were first rolled during 1857 in Dowlais, South Wales. About 1867 came the open-hearth process, an international achievement, made a success by Emile and Pierre Martin, iron manufacturers of western France, using a furnace developed in England by a native of Germany, the distinguished Charles William Siemens.

During the next few years the applications of steel to engineering followed thick and fast, although I shall note only two. The first steel-tired car wheel was turned out in 1870. More significant was the great Eads Bridge across the Mississippi at St. Louis, completed in 1874—the first bridge in which any structural steel was used. The decade beginning about 1870 also marked the construction of what was for years the world's greatest bridge—Roebling's Brooklyn Bridge, spanning the East River at New York. Steel began to come into general use for American bridges about 1890.

MODERN TUNNELING METHODS DEVELOPED

Modern long railway tunnels, subaqueous tunnels, and subways did not arrive until the third generation. The two pioneer feats in railway tunneling, both completed in the seventies, were the Hoosac Tunnel piercing the Berkshires in Massachusetts and the Mt. Cenis, piercing the Alps. Although the latter is much the deeper and longer, these are comparable achievements, both serving as experimental laboratories in the development of tunneling machinery and blasting methods. Percussion drills were invented in America in 1849 and later used on the Hoosac Tunnel; a power drill was also developed by the engineer of the Mt. Cenis Tunnel in

1857. Nitroglycerin was brought into general use by Nobel in 1863; dynamite was used on the Hoosac Tunnel soon after Nobel invented it in 1867.

The compressed-air method for tunneling under water is due first to a picturesque British naval hero, an adventurer if there ever was one, Admiral Sir Thomas Cochrane, who in 1830 took out a patent which did not come into practical use for many years. Meanwhile, in 1843, the elder Brunel had somehow struggled bravely through with his Thames Tunnel, without compressed air. Coupled with Cochrane's invention and supplementing it, was the invention by two Britishers, in 1869, of the Greathead shield, which could be pushed forward as the tunneling advanced. These two inventions gave the British the lead in this type of construction and they maintained it for many years.

ISAMBARD K. BRUNEL, SON OF THE BUILDER OF THE THAMES TUNNEL, WAS AN EVEN MORE FAMOUS ENGINEER

Another type of tunnel was also first developed by the British—the tunnels under city streets, which Americans call a subway. The first of these to be built was the shallow London Metropolitan-District Railway, designed to connect some dozen railway stations with each other. A portion of this was completed during our Civil War at a cost of three million dollars a mile. The tube railways (the "tupenny tubes") much deeper and of an entirely different type, were begun in the eighties. The Paris subways followed those of London, with the New York system third.

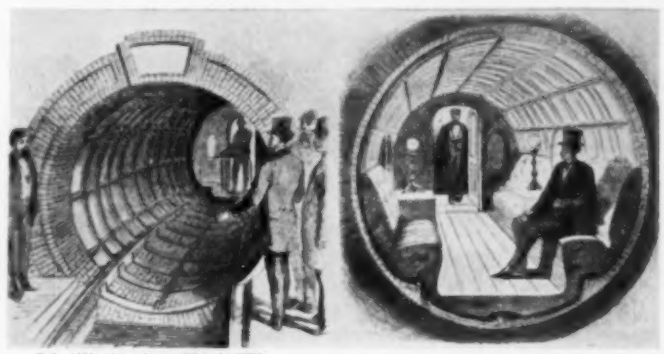
BIRTH OF SANITARY ENGINEERING

Not until well along in the nineteenth century was it recognized that the civil engineer could be at all concerned with the health of communities. In fact, sanitary engineering, as we understand it, is almost wholly the work of the third generation. In 1829, the year typhoid fever was christened, James Simpson, engineer of the Chelsea water-works system on the Thames at London, built the first artificial sand filters. Simpson had probably never heard the word bacteria; he aimed simply to improve the appearance and taste of the river water. Twenty years later, in 1849, an English physician expounded the "peculiar doctrine" that the cholera, which had been raging in London, was due to excreted matter taken into people's mouths with the water they drank. It was not long before the British government set up a filtering requirement for public supplies (all this before the germ theory of disease had even been authoritatively enunciated). The British were, then, the pioneers in the filtration of water supplies.

The science of bacteriology, which developed in the seventies, largely in Germany, on foundations laid by Pasteur, came to be recognized early in the eighties. From this point on, the most significant step was the establishment in 1887, at Lawrence, Mass., of an experiment station at which, in 1893, a sand filter was constructed. This was the first to be set up anywhere with the distinct purpose, not of clarifying the water, but of lowering the community's death rate.

BEGINNINGS OF REINFORCED-CONCRETE CONSTRUCTION

Carefully proportioned cement concrete as we know it, and even the name itself, is less than a century old. The reinforcing of concrete by means of embedded iron or steel has been extensively practiced for not much more than a generation. However, the discoveries which led up to it date back to the nineteenth century, to an Englishman, two or three Frenchmen, and an American or two. Joseph Monier, a gardener who raised and sold shrubs and plants in Paris, patented in 1867 a system in which iron netting was embedded in cement mortar; he made lighter and stronger tubs or basins that way. Monier had been preceded a dozen years before in England by a plasterer, one Wilkinson, who put hoop-iron into concrete floors in a fashion we should even now call clever and logical. And in 1849 one Lambot had made a concrete-and-iron boat, which (I trust) may still be afloat somewhere in France. Monier's system was gradually expanded, first from pots to reservoirs, and eventually to bridges; his patents were developed extensively in Austria rather than in France.



Scientific American, March, 1870

THE BEACH PNEUMATIC RAILWAY, BUILT IN NEW YORK CITY IN 1868–1870

This Subway Actually Ran Under Broadway from Murray to Warren Streets, But Did Not Pay and Was Later Abandoned

One American who might be mentioned in this connection is William E. Ward, a bolt manufacturer, whose reinforced-concrete castle-like residence, dating from 1872, the first in America built of this material, may still be seen on a hill west of Greenwich, Conn. Another is Thaddeus Hyatt, a New York lawyer with an engineering mind. Hyatt made a substantial contribution to engineering, for in a little book, published in England in 1877 and now scarce, he first correctly analyzed the forces in a reinforced beam.

I realize that in this brief summary I have entirely ignored some fields in which civilian engineers have been and are engaged, and have devoted only cursory attention to others. My chief interest has been in the growth of the main stem of engineering through the century immediately preceding our own, rather than in the branches which the progress of invention and the ever-increasing complexity of modern life have brought into being. It is cheering to observe that there are portents, in the technical schools and universities at least, that the many subdivisions of the parent profession may yet become better coordinated, even reunited, into a symmetrical whole, more surely founded and broader in its outlook than in Smeaton's day.

ENGINEERS' NOTEBOOK

From everyday experience engineers gather a store of knowledge on which they depend for growth as individuals and as a profession. This department, designed to contain ingenious suggestions and practical data from engineers both young and old, should prove helpful in the solution of many troublesome problems.

Life of Rail on Steam Railroads

By George W. Hunt

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The service life of rail is a matter of prime importance, but data on the subject are usually qualified by so many conditions as to be confusing rather than information. The present article attempts to simplify and correlate the data, and concludes with a brief discussion of the economy of welded construction.

In practice, the first life of rail is usually governed by one of two conditions, which may exist separately or in combination: (1) Deterioration of joint and surface conditions, resulting in rough track, uncomfortable riding, and excessive maintenance; (2) Abrasion of the rail head beyond the limits of safety. On straight track and light curves the first of these conditions will naturally govern; on sharp curves, the second. On intermediate curves both conditions may influence the life.

The two independent variables, degree of curvature and amount of traffic, are generally recognized as the two prime factors in determining abrasion on curves. Train speed and superelevation of the high rail are normally minor variables dependent largely upon the curvature, and under given traffic and grade characteristics are more or less constant for any degree of curve. Marked differences in abrasion, however, will occur on opposite tracks of the same curve on long heavy grades, because of the difference in speeds uphill and down. This condition is common on pusher grades, and results generally in reducing the life of rail on the high side of curves on descending tracks to as little as half of what it would be on level or rolling grades. On the other hand, rail on the ascending curves may never wear out from flange abrasion.

Long heavy grades are of course exceptional. It will be understood, therefore, that any statement of rail life, predicated on curvature and tonnage, will apply only to level or undulating grades.

Track gage, at least theoretically, can be accepted as a constant for all curves of the same degree. It is worth noting, however, that abnormal abrasion will result if sharp curves are laid with tight gage—a not uncommon practice on the part of track forces, and one that must be taken into account in comparing results of abrasion tests.

The life of rail, as influenced by tonnage and curvature, is shown in Fig. 1. The graphs were arrived at from a careful study of the result of abrasion tests on curves of various degrees under known tonnage. An abrasion of 1.15 sq in. (25 per cent of the head area of a 130-lb A. R. E. A. rail) is regarded as the limit of wear. The tests used were made mostly on tracks carrying both passenger and freight trains, and the graphs are believed to agree fairly well with the experience and practice of most railroads. The discussion applies to the low rail of curves generally, as well as the high rail; for what wear the low rail escapes because of small flange abrasion is usually offset by a more rapid tread wear or rolling out of the metal due to the excess load placed on it by more slowly moving trains.

A total tonnage of about 500 million tons appears to be required to reduce the metal in the head of a 130-lb rail by 25 per cent. The extreme theoretical limit of life, as indicated by the intercepts of the graphs with the zero-degree line, were determined on this basis.

Poor joint and surface conditions frequently make necessary the removal of rail after it has carried about 240 million tons. It follows from the graphs, therefore, that abrasion has no practical influence in reducing the life of rail on tangents and light curves up to 4 deg, the primary cause for removal under such alinement being poor condition of joints and surface.

While joints and surface start to deteriorate as soon as the rail is laid, conditions sufficient to arouse criticism do not usually occur until the rail has carried about 100 million tons, which would mean after about five years of service on tracks carrying a "medium" tonnage of 20 millions per year. The graphs show that 100 million

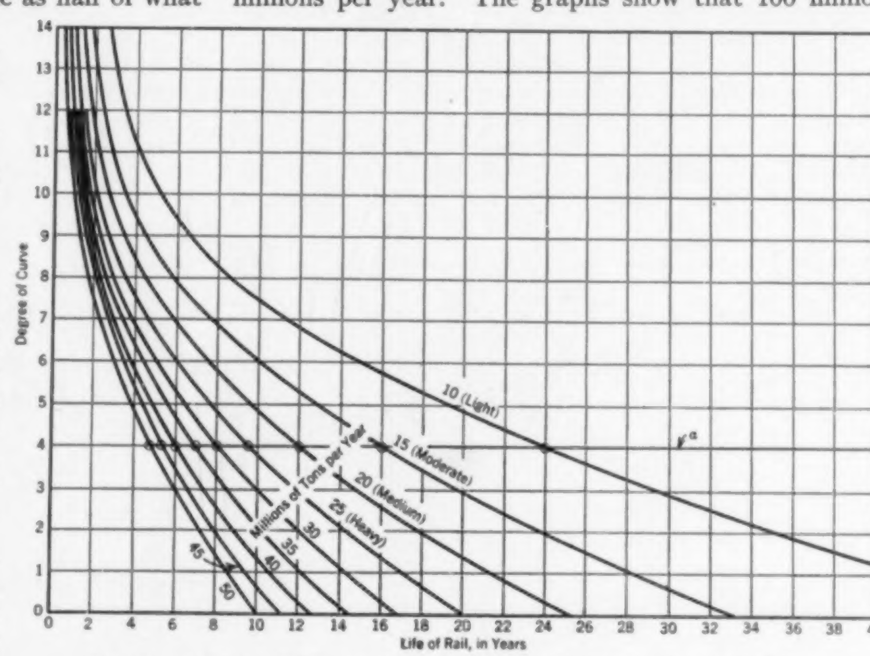

Fig. 1. Life of Rail as Influenced by Tonnage and Curvature

Even on Tangent, Life of Rail on Important Passenger Lines Is Frequently Limited to 240 Million Tons. This Limit Is Indicated by Intercepts of the Curves with Line (*a*)

tons will result in sufficient abrasion to cause the removal of rail on curves greater than $7^1/_2$ deg. It follows, therefore, that for curves of $7^1/_2$ deg and over, abrasion is the dominating factor in determining rail life. Between the limits of $7^1/_2$ and 4 deg, abrasion becomes decreasingly important, and joint and surface conditions increasingly important.

Inasmuch as curves in excess of $7^1/_2$ deg constitute but a minor fraction of track mileage, it may be said that rail life, in a broad sense, is limited by the deterioration of rail joints and rail ends. This limit, as indicated by the graphs, will vary directly with the traffic, ranging from 9 years for "heavy" traffic to 24 years for "light." The average may be taken as 15 years.

Engineers have been trying for many years to increase these limits by such expedients as re-forming or renewing joint bars, and by welding up battered and chipped rail ends. These attempts have been only moderately successful and, in some instances, of doubtful economy. More recent attempts have had for their object the hardening of the rail ends to reduce batter and chipping. All such methods aim to alleviate the effects, rather than to remove the cause, of the disease.

It is doubtful if any great progress or economy in increasing rail life will be made until the rail joint is finally eliminated from general use. The welding of rail is the first serious step in that direction. As such, it deserves the thoughtful consideration of all officers whose duties require them to maintain an efficient track structure at the least possible expense.

Table I shows the economy of welded rail, taking into account the fact that the life of accessories is usually fixed by the life of the rail itself. To the annual savings

TABLE I. ECONOMY OF WELDED TRACK, PER MILE

Item	Present Practice (Life 15 Yrs.)	Welded Track Life 20 Yrs.	Welded Track Life 25 Yrs.
First cost:			
(1) Rail (131-lb track)—205 tons @ \$40	\$ 8,200	\$ 8,200	\$ 8,200
(2) Tie plates—5,540 @ \$0.40	2,216	2,216	2,216
(3) Rail joints—bolts and washers, 270 @ \$5	1,350	.....	.....
(4) Welding rail ends—270 @ \$7	.....	1,890	1,890
(5) Anticreepers—1,620 @ \$0.20	324	648*	648*
(6) Track spikes—60 kegs @ \$5	300	300	300
(7) Labor of laying rail and loading scrap	600	600	600
Total first cost	\$12,990	\$13,854	\$13,854
Annual charges and credits:			
Annuity to replace in kind	\$ 602	393	290
Interest at 5%	650	693	693
Salvage from scrap (30% of Items 1–6)—\$3,717	Cr.172	.....	.....
Salvage from scrap (30% of Items, 1, 2, 5, 6)—\$3,409	.....	Cr.103	Cr.71
Total annual charges	\$1,080	\$ 983	\$ 912
Saving per track mile per year in renewals	.....	\$ 97	\$ 168

* More substantial anchorage required for welded rail.

in renewals there indicated should be added the saving in labor charges for maintaining track surface, which may be conservatively taken as \$100 per track mile. It may be conservatively stated, therefore, that welded rail will cost \$864 per track mile more than the present type of construction in initial outlay, but will save \$200 per track mile per year in maintenance after it has once been installed.

Formula for Passive Earth Pressure

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ALTHOUGH the active earth pressures acting on vertical walls are quite thoroughly treated in the current technical literature, the treatment of passive earth resistance is generally limited to the special case of a horizontal ground line. The formula developed here will prove useful in analyzing stresses in sheet piling driven into sloping banks. In this article passive earth pressure is defined as the opposition of cohesionless soil to lateral displacements of a vertical, frictionless wall.

In Fig. 1 the weight of a prism ABC is proportional to the area of the triangle ABC and can be represented by $BC_1 = x$; the angle, ϕ, between BC_1 and the horizontal equals the angle of repose for the material. Triangle bc_1d is triangle BC_1D (drawn to a smaller scale) rotated through an angle equal to $90° + \phi$. It is seen that $C_1D = y$ is the horizontal thrust which, combined with the weight of the prism, gives the force DB that will produce rupture along the plane BD.

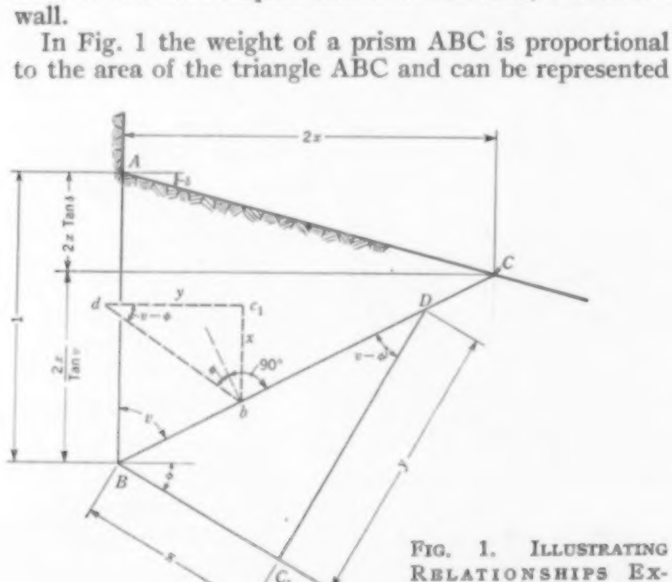

FIG. 1. ILLUSTRATING RELATIONSHIPS EXPRESSED BY EQS. 1 AND 2

The passive soil resistance is now determined by varying x until y becomes a minimum. If the distance AB equals unity, it is seen that

$$2x \tan \delta + \frac{2x}{\tan v} = 1 \qquad [1]$$

and

$$\tan (v - \phi) = \frac{x}{y} \qquad [2]$$

Eliminating the angle, v, between Eqs. 1 and 2 gives

$$y = \frac{x + 2x^2(\tan \phi - \tan \delta)}{2x(1 + \tan \delta \tan \phi) - \tan \phi} \qquad [3]$$

Differentiating Eq. 3 and placing the result equal to zero gives

$$x = \frac{\tan \phi \sqrt{\tan \phi - \tan \delta} + \sqrt{\tan \phi (\tan^2 \phi + 1)}}{2(1 + \tan \delta \tan \phi) \sqrt{\tan \phi - \tan \delta}} \qquad [4]$$

and substituting in Eq. 3,

$$y = C = \frac{\sqrt{(\tan\phi - \tan\delta)\tan\phi(\tan^2\phi + 1)} + \tan^2\phi - \frac{1}{2}\tan\phi\tan\delta + \frac{1}{2}}{(1 + \tan\phi\tan\delta)^2} \qquad [5]$$

The total passive resistance for a depth, h, below A is therefore

$$P = wCh^2 \qquad [6]$$

where w equals the weight of earth in pounds per cubic foot.

If the surface of the earth is horizontal it is found that

$$C_{\delta=0} = \tan\phi\sqrt{\tan^2\phi + 1} + \tan^2\phi + \tfrac{1}{2}$$
$$= \tfrac{1}{2}\tan^2\left(45^\circ + \frac{\phi}{2}\right) \qquad [7]$$

and if AC is parallel to BC_1,

$$C_{\delta=\phi} = \tfrac{1}{2}\cos^2\phi \qquad [8]$$

Values of C, computed from Eq. 5, are listed in Table I. It is seen that in case of a slope steeper than the angle of repose, ϕ, only such earth as is lying below a plane making an angle of ϕ with the horizontal can be counted on as exerting passive resistance.

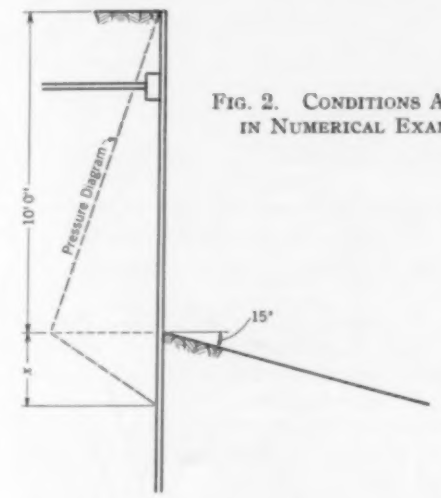

FIG. 2. CONDITIONS ASSUMED IN NUMERICAL EXAMPLE

It is known to designers of bulkheads that the passive earth pressures developed by Coulomb's theory, including Eqs. 5, 6, 7, and 8, can be multiplied by an efficiency factor which for undisturbed soil is generally taken to be equal to 2.

As a practical application of Eq. 6, consider the bulkhead in Fig. 2. It is held at the top by horizontal tie

TABLE I. VARIATION OF COEFFICIENT C

Values of δ	Values of C for θ = 5°	10°	15°	20°	25°	30°	35°	40°	45°
0°	0.5955	0.7101	0.8492	1.0198	1.2320	1.5000	1.8451	2.2995	2.9142
5°	0.4962	0.6309	0.7521	0.8962	1.0716	1.2887	1.5620	1.9129	2.3737
10°	....	0.4849	0.6477	0.7757	0.9239	1.1022	1.4846	1.5963	1.9478
15°	....	....	0.4665	0.6497	0.7985	0.9330	1.1118	1.3301	1.6023
20°	....	....	....	0.4415	0.6385	0.7741	0.9241	1.1007	1.3147
25°	....	....	....	....	0.4107	0.6152	0.7508	0.8982	1.0697
30°	....	....	....	....	....	0.3750	0.5813	0.7146	0.8564
35°	....	....	....	....	....	....	0.3355	0.5379	0.6657
40°	....	....	....	....	....	....	....	0.2934	0.4872
45°	....	....	....	....	....	....	....	....	0.2500

rods and laterally supported at the bottom by the passive resistance of the sloping ground which is assumed to make an angle, δ, with the horizontal equal to 15 deg. The angle of repose, θ, is assumed to be 30 deg. The problem is to find the depth, x, to the theoretical point of support. It should be noted that P in Eq. 6 denotes the total passive earth pressure at the depth h; the unit passive earth pressure at this depth is obtained by multiplying the product $2hw$ by the values given in Table I. The theoretical point of support is the one at which unit active pressure becomes equal to unit passive pressure, hence:

$$2Cwx = w(10 + x)\tan^2\left(45^\circ - \frac{30^\circ}{2}\right) \qquad [9]$$

From Table I the proper value of C is found to be 0.933. Substituting and solving, $x = 2.18$.

A Drumhead Pipe Stopper

By H. D. HURLEY

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IN pipe sewer construction it is frequently necessary to build a manhole, place a bulkhead, or make a connection down grade from work already completed. In such cases infiltration becomes troublesome.

The usual device for holding the water back from the new work is a sand-bag dam, but this is not always satisfactory and the sand bags are often lost.

In order to make control positive, I recently designed, constructed, and successfully used a temporary stopper consisting of an internal expanding diaphragm of wood fitted with an overlapping membrane of rubber. The details are shown in Fig. 1.

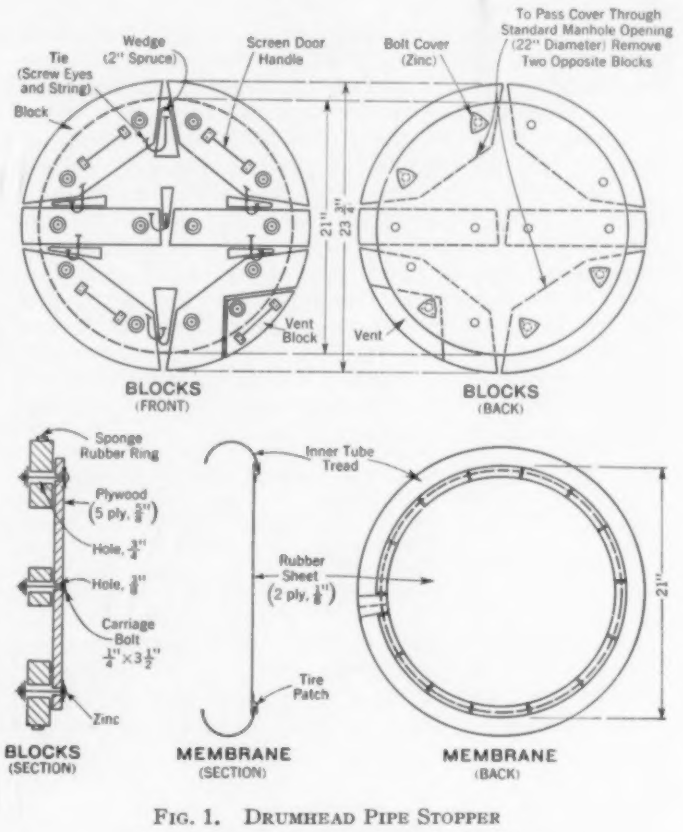

FIG. 1. DRUMHEAD PIPE STOPPER
Dimensions Shown Are for a 24-In. Pipe

The materials are inexpensive and the craftsmanship need not be precise. Friction holds the stopper in place without the help of braces. The time required for installation is a matter of minutes only, and for removal, even less.

Segmental Division for Arch Analysis

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THE usual method for dividing an arch into segments having $\Delta s/I$ constant, by drawing similar isosceles triangles, and obtaining the desired number of divisions by a cut-and-try process, is not very accurate and sometimes requires numerous trials. The following proposed method is more exact theoretically and requires no successive trials.

In the method heretofore used, the curve for I is laid out with the axis (developed to a straight line) as the base. By trial a series of similar isosceles triangles are drawn, so that $\Delta s/I$ is constant, as shown in Fig. 1. In this method the I at the center of the division is taken to represent the mean value of I for the division, and this is not quite correct.

The proposed method utilizes the properties of the $1/I$ diagram instead of the I diagram. If we use the semi-arch axis length as the base, as before, we can plot $1/I$ instead of I, as ordinates. For convenience we can take $1/I$ at the crown as unity and plot the relative $1/I$ values. This curve is shown in Fig. 2. Since $\Delta s/I = C$, we see that, for any given segment in this figure, c is the area under the $1/I$ diagram (shaded area). If $(1/I)_m$ is the mean value of $1/I$ in this interval, $C = \Delta s(1/I)_m$, as it should.

Thus we see that our problem is to divide the area under the $1/I$ curve into n equal areas, where n is the number of segments desired. This can be accomplished by first obtaining the ΣA curve, where ΣA is the sum of the areas, starting at the center line. By dividing our base into any desired number of equal divisions, we can add the areas under the curve corresponding to these divisions, progressively from the center. The resultant curve is shown in Fig. 4. We now divide the last ordinate into n equal divisions, and project horizontally until we intersect the ΣA curve. From this intersection we project vertically to the base, and we have the desired segments, Δs.

The curve of Fig. 4 corresponds to the arch shown in Fig. 3. Twelve divisions were used, and data for the first two divisions are shown in Table I.

TABLE I. COMPUTATIONS FOR ΣA-CURVE

POINT	t (ft)	t^3	RELATIVE $1/I$	ΣA
(1)	(2)	(3)	(4)	(5)
0 (Crown of arch)	3.000	27.000	1.00000	0
1	3.015	27.407	0.98515	0.99258
2	3.060	28.653	0.94231	1.96097

The thickness of the arch ring was first computed and entered in Col. 2. Then t^3 was computed and entered in Col. 3. The relative value of $1/I$ was next found, and since $1/I$ at the center was taken as unity, the relative value of $1/I$ is equal to t_0^3/t^3 (Col. 4). Finally, ΣA was computed and tabulated in Col. 5. The first value, 0.99258, was found by considering the area between points 0 and 1 as a trapezoid, with unit base, taking the length of each of the equal divisions as a unit length. To get ΣA_2, Simpson's rule was used, with multipliers 1, 4, and 1. Thus

$$\Sigma A_2 = \frac{1.00000 \times 1 + 0.98515 \times 4 + 0.94231 \times 1}{3} = 1.96097$$

By means of a calculating machine, the result can be obtained rapidly. The other ΣA values were computed in a similar manner using Simpson's multipliers:

For 4 ordinates, $1-3\frac{1}{2}-3\frac{1}{2}-1$
For 5 ordinates, $1-4-2-4-1$
For 6 ordinates, $1-4-2\frac{1}{2}-2\frac{1}{2}-4-1$
and so forth.

The ΣA curve of Fig. 4 was plotted from the data in Col. 5, using the equal divisions as units of length horizontally. Next, the last ordinate was divided into 12 equal parts, and projected to the curve and thence to the base to obtain the required segment lengths. Note that each unit of length along the base must be multiplied by 8.693 ft, the length of each of the equal divisions first used. For greater accuracy, Fig. 4 should be drawn to a larger horizontal scale.

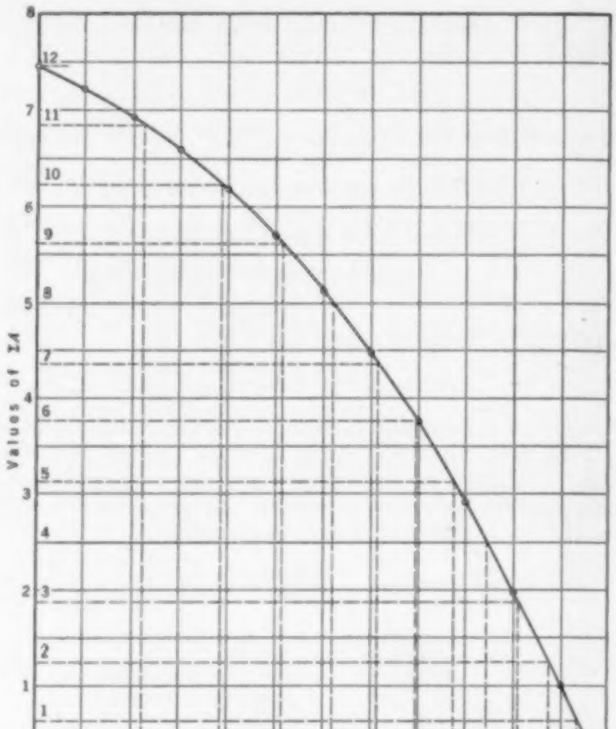


FIG. 4. SEGMENTAL DIVISION BY USE OF ΣA-CURVE

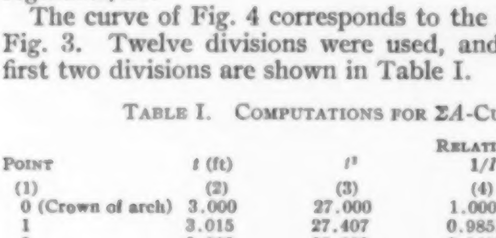


FIG. 1. TYPICAL I-DIAGRAM

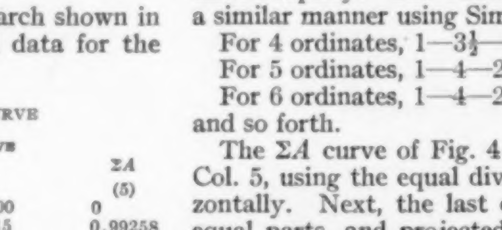


FIG. 2. TYPICAL $1/I$ DIAGRAM

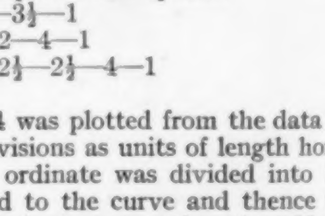


FIG. 3. ARCH DIMENSIONS

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Comments on Engineering Curricula

To the Editor: It is refreshing to read such an article as that entitled "What Should the Technical School Teach?" by Scott B. Lilly, M. Am. Soc. C.E., in Civil Engineering for November. To have a professor of engineering declare himself so admirably must be encouraging to those interested in engineering education—both those who are in our schools of engineering and those who are outside.

The endeavor should be, as Professor Lilly suggests, to make the profession of engineering as much an applied science as possible. To emphasize the art of engineering is to confess in a way to lack of understanding of modern developments in engineering. Engineering was once almost wholly an art. But it is becoming more and more an applied science, and it is at least as accurate today to speak of the science of engineering as it is to speak of the art of engineering. I believe it is more accurate. Engineering will always be both a science and an art, the latter properly beginning where the former leaves off. Advance lies in continually pushing forward the point where science leaves off. The schools can do much in teaching the science of engineering; they can do little in teaching the art. The art must be acquired largely by doing—later, in practice.

I think that Professor Lilly could have made a stronger case for mathematics. Unfortunately one reason why some practicing engineers do not have occasion to use the calculus is that they are not able to use it. They are under a distinct handicap. It seems to me that students who do not show an aptitude for mathematics and physics or chemistry should be dissuaded from going into engineering. These three subjects are fundamental, and it is becoming increasingly difficult to reach the top ranks of the profession without a thorough grounding in them.

Professor Lilly's remarks concerning the two courses in structures are illuminating. The course based on the use, not on understanding, of a widely adopted set of specifications is all too common. I have often thought how worth while a course could be which consisted largely of the study of a few well-known specifications. The purpose would be to discover, so far as possible, the reasons for all the provisions in the specifications. Some of these provisions are purely the result of experience; others are based on tests. Instructor and student should study some of these tests together and see whether the codification of the results in the specification is reasonable. Still other provisions of a specification may be based almost entirely on theory. Let us reexamine this theory, review it, and convince ourselves that it is properly applicable. Such a course would be valuable.

Professor Lilly's division of the four-year curriculum is the best that can be made, but four years are not enough if the engineer is to take as prominent a place in society as that occupied by the doctor or the lawyer. Six years will be necessary—four years of regular college work, specializing in mathematics, physics, and chemistry, followed by two years of professional-school work. A young man equipped with this formal education and fundamental knowledge is in a position to get ahead.

It is true that many prominent and successful engineers have not had this type of education, but it is also true that an increasing proportion of the men who rise high in the profession have had it. Furthermore, there are many, many border-line cases of men called engineers whose work demands only a superficial knowledge of engineering. To their formal education this letter does not apply. It would be better if, as students, such men could be separated from the men primarily interested in a technical education. The business school of today could be better adapted to their needs than the engineering school.

Wm. R. Osgood, M. Am. Soc. C.E.
Materials Engineer, National Bureau of Standards

Washington, D.C.
November 13, 1937

Finding the Length of a Howe Truss Brace

To the Editor: On page 634 of the September issue of Civil Engineering is shown a method of finding the length of a Howe truss brace. I remember trying this method once, but got troubled by the difference in length between the top and lower chords on account of the camber.

The practical way, as I learned from some dozen old "framers," was to lay out a panel, full size, on a floor (building the floor, if necessary) and measure the braces on it.

C. D. Purdon, M. Am. Soc. C.E.
Retired Consulting Engineer,
St. Louis Southwestern Railway

St. Louis, Mo.
November 28, 1937

Allocation of Highway Taxes

To the Editor: The paper on "Highway Traffic and Motor-Vehicle Taxation" by Murray D. Van Wagoner, in the October issue, is timely. Undoubtedly, sound principles of highway finance have been sidetracked in many states during the depression, and it will take considerable effort to get them into service again. That motor-vehicle users should pay a large part of the cost of the service they require is fair, but that they should pay for all highway service is certainly unsound. Not all of the demand for service is by the users. The community as a whole must have roads, and access to land and homes must be provided.

The concept of highways as public utilities is sound, and I believe that established principles of public utility management could well be applied to highway finance and administration. Highways, however, differ in several respects from ordinary commercial utilities. A much larger proportion of highway operations involves extension of facilities, construction, and reconstruction. On this account the highway utility must each year, in addition to its operating costs, provide for additional capital investment. This yearly access of capital must, in the end, come from annual road revenues, since there is no stock to be sold and public finance does not contemplate permanent bonded indebtedness. Whether this capital should be provided by the community at large or by the users of the service is a debatable question.

Since the highway utility is not operated for profit, its annual cost is not strictly comparable with that of the commercial utility. In commercial accounting interest is not a cost item. It is a return on the capital investment, and if the revenues are sufficient to pay interest as well as cost the business is making a profit. On a highway system interest on debt is an item that must be met from yearly revenues and so may be considered an item of annual cost. At least the public must pay it along with operating costs.

What are highway earnings? Are they simply license fees and gas taxes, or should they include revenues from general taxes and special assessments? Although there was a tendency during the depression to place the highway burden upon the users, the community as a whole must have highways and in fairness it should pay part of the cost, as Mr. Van Wagoner has shown. There is no formula for dividing the costs of the different classes of roads among the groups benefited. From a thorough study of all the pertinent facts in one jurisdictional or traffic pattern area some useful relationships could probably be deduced. Possibly the information being accumulated by the numerous planning surveys can be used for some studies of this kind.

Unfortunately no way of charging road users directly in proportion to their use of specific highways has yet been found. The charges must be collected through the taxing power of the state. This brings up the interesting problem of the distribution among various classes of highways of the user taxes. These taxes are

levied without respect to road or street systems, and the payers use the roads and streets indiscriminately. Since all highways must generate some of the total revenue, it is natural for the authorities in charge of the various systems to feel entitled to some share of the proceeds.

In the case of the gasoline tax it should be possible by means of traffic surveys and statistics of fuel consumption to determine the relative amounts generated by trunk roads, secondary roads, local roads, and municipal streets, and an initial allocation made on this basis.

The license fee, or privilege tax, is different in nature. Although paid by users of all roads and streets, it bears no relation to amount of usage and may well be considered in the category of the readiness-to-serve charge of most public utilities. The practice of many states in devoting this money wholly to the state road system appears to be justified on this basis.

ROY W. CRUM, M. Am. Soc. C.E.
Director, Highway Research Board, National Research Council

Washington, D.C.
December 3, 1937

Early Engineering

DEAR SIR: After reading with much interest the article, "Some Engineering Beginnings," by Richard S. Kirby, M. Am. Soc. C.E., in CIVIL ENGINEERING for November, it occurs to me that the following translations from the cuneiform may be of interest to your readers.

From the tablets of Hammurabi (circa 2200 B.C.) there is the following: "I have made the canal of Hammurabi a blessing to the people of Sumer and Accad. I have distributed the waters by branch canals over the desert plains. I have made water flow in the dry channels and have given an unfailing supply to the people. I have changed desert plains into well watered lands. I have given them fertility and plenty and made them the abode of happiness."

Another letter by the same gentleman reads: "The canal was dug but it was not dug clear into Erech so that the water does not come into the city. This is not too much for the people at thy command to do in three days. Directly on receipt of this writing, dig the canal with all the people at thy command clear into Erech within three days. As soon as thou hast dug the canal, do the other work which I have commanded."

A record by Darius, the Persian, discovered on a tablet dug up during the construction of the Suez Canal (circa 510 B.C.), reads: "I commanded this canal to be built from the Nile which flows in Egypt to the sea which comes from Persia. So was this canal built as I had commanded and ships passed from Egypt through this canal to Persia, as was my purpose."

As an example of primitive engineering in America I might refer to two very remarkable bridges built by Indians in British Columbia. These were cantilever structures, and views of them are given in Vol. I of *Bridge Engineering* by J. A. L. Waddell, Hon. M. Am. Soc. C.E.

H. B. MUCKLESTON, M. Am. Soc. C.E.
Consulting Engineer

Vancouver, B.C.
November 30, 1937

A Highway Water Supply System in West Virginia

TO THE EDITOR: In connection with the article entitled "Safe Roadside Water Supplies in Ohio" by F. D. Stewart, M. Am. Soc. C.E., in the October issue, I should like to comment on the situation in West Virginia. The inspiration for the work done in West Virginia on highway water supplies came from Ohio's far-sighted public health statesman, the late Dr. John E. Monger, former State Health Commissioner.

The mountains in West Virginia abound in spring waters, which have been developed, properly protected, and piped to the highways for the benefit of the auto travelers. The West Virginia Department of Health, Division of Sanitary Engineering, has endeavored to make the general public realize the value of safe drinking water by (1) erecting "Safe City Water" signs at the corporate limits of cities having approved public water supplies, and (2) assisting the State Road Commission by developing springs adjacent to state and federal highways and marking them by standard approved signs.

If the control of railroad water supplies used for drinking purposes is considered of prime importance by the Public Health Service in controlling the spread of intestinal diseases, how much more important is it to examine, control, and publicly approve the drinking water used by the general public traveling by automobile from one state to another. The problem becomes increasingly acute when travel by trailer is considered.

In West Virginia there is a definite connection between the visible "Safe City Water" sign at the corporate limits of a city and the invisible trained operating personnel in charge of the water purification system supplying a city or town with drinking water. The design of the water purification plant is required by state law to be approved by the State Department of Health engineers, but more important than this is the person in charge of the water plant operation. Before this superintendent or operator takes charge of the water purification plant in West Virginia, he must qualify by education, training, and experience for his important position. He is required to take a written examination, prove his fitness for the position, and obtain a license from the State Department of Health.

For a period of ten years the State Department of Health, Division of Sanitary Engineering, and the State Road Commission have been cooperating in developing a system of public drinking fountains along the main highways. The first sign was erected in July 1926. The State Road Commission has built stone or masonry structures around the drinking fountains, protected the spring in accordance with detailed instructions from the State Department of Health engineers, and piped the water to the fountain along the highway. Furthermore, the springs are carefully examined before being developed, and safe, palatable, water supplies are thus secured. The highway engineers have planned proper parking areas at these springs, and long lines of automobiles are frequently noticed at these parking places. Such facilities have engendered a strong feeling of good will in the general public.

There are two important points in the control system which are of prime importance. Absolute safety of the water must be assured, in so far as it is humanly possible, and to bring this about a regular systematic bacteriological examination of these waters is undertaken. The second important point is keeping the parking area around the fountain clean and neat. The traveling public is attracted by neat, clean conditions around the drinking fountain, but is repelled by littered, trash-strewn surroundings.

Among the beneficial results of this roadside sanitation program in West Virginia, besides the matter of convenience to the traveling public, is a substantial improvement in public health due to the emphasis on safe drinking water. The highway water supplies have served to emphasize the value of safe, palatable water for every community. Consequently, the number of small water-purifications systems has increased, and the licensing system for operators of water-purification plants has been developed with considerable success, resulting in less turnover in trained water-works personnel.

E. S. TISDALE
Director, Division of Sanitary Engineering, West Virginia Department of Health

Charleston, W.Va.
December 5, 1937

Errata in Captions, December Issue

Editor's Note: Errors in the captions of the first three illustrations for the symposium "Land Registration and Plane Coordinates in Massachusetts," published in the December 1937 number of CIVIL ENGINEERING, were discovered too late to make the necessary corrections before that issue went to press. The captions for the photographs of the boundary markers at the foot of page 824 and at the top of page 825 should have been interchanged. In addition, the subcaption of the photograph of the angle-tree monument at the foot of page 825 should have read "This Stone Marks the Old Boundary Line Between Massachusetts Colony and Plymouth Colony. It Is Now Between North Attleboro and Plainville."

Planning for Subsurface Utilities

To the Editor: I should like to comment on the article entitled "Need for Subsurface Utility Planning" by A. W. Consoer, M. Am. Soc. C.E., in the October issue. The need for subsurface utility planning is very forcibly brought home to us in the older sections of long-established cities. Much of the original underground work was installed without thought of expanding facilities and certainly without reference to the unforseen complexities of the modern city. Too often the only records that were kept were in the mind of a foreman, who no doubt perpetuated his job by being the only one who knew locations. The result was usually that the first utility took the center of the street and left those facilities that came in later to work out their own salvation.

Fortunately, sewers as a rule have been laid first, and they have usually been of sufficient depth so that other facilities could cross over them without any trouble. In many cases, however, due to inadequate depth or improper design, they have presented very definite obstacles to orderly development. Also, the original sewers were as a rule designed to take care of only a limited area and thus prove insufficient in size to serve an expanding community, with the result that when relief sewers or additional sewerage facilities are to be built, the problem of location is often very serious.

It is claimed that in the older locations little can be done except to perpetuate existing chaotic conditions, because of the cost of making the necessary changes. However, there are few utilities that do not need replacement or extensive alterations, and frequently relocations can be made to fit into an orderly development.

Street-widening operations present a golden opportunity to do a constructive planning job. This was illustrated in the recent widening of Woodward and Gratiot avenues in Detroit, to a total of 120 ft between property lines. In the accompanying Fig. 1 is shown a typical cross-section of the utility planning, which was laid out with the idea of keeping the digging in the street to a minimum after installation. As we had found that paving cuts to gas and water mains are the most prolific sources of paving disturbance, these were laid out under the sidewalks, so there would be no disturbance of the street. A separate gas and water line serves each side of the street.

Space is reserved adjacent to the curb, and inside the sidewalk line, for street lighting conduits and poles. The conduit for the city electrical services has ducts to all possible safety zone locations and to every intersection where the various city services might be anticipated in the future. Our experience of two and a half years on the Woodward Avenue relocation indicates the value of the efforts

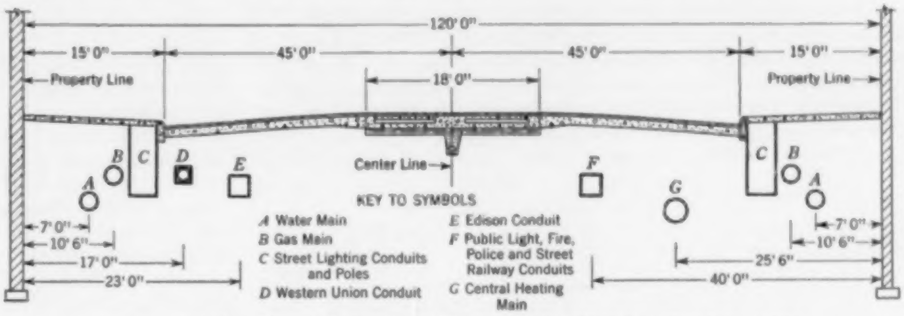


Fig. 1. Typical Cross-Section of Woodward Avenue, Detroit, Mich., After Widening from 74 to 120 Ft

spent on planning utility location, and the plan will be adopted for all future widening.

In residential and outlying districts, the city of Detroit has insisted for years on lateral sewers being built either in the alleys or easements in the rear of the lots. Gas and water mains are laid out as much as possible in the grass plats between the sidewalk and the curb on either side of the street. Service connections are jacked from one side to the other, wherever possible, with a minimum of disturbance to the street.

In the city of Detroit we insist that utilities install or renew their work in the streets, in advance of new paving, and we give them notice at the beginning of the year as to contemplated construction. Utilities have been quite cooperative in this respect, especially since there is a charter provision for charging three times the value of the paving repairs for cut in the first year of installation, two times the value in the second year, and the normal cost in the third and ensuing years.

L. G. Lenhardt, M. Am. Soc. C.E.
Commissioner, Detroit Department of Public Works

Detroit, Mich.
December 4, 1937

Compensatory Works for Rivers and Lakes

To the Editor: The article, in the October issue, on "Compensatory Works for St. Clair River," by C. R. Pettis, M. Am. Soc. C.E., and Sherman Moore suggests a number of points for discussion.

The amount of compensation computed by the authors to be necessary to restore the "natural levels" of Lakes Michigan-Huron is given as 0.73 ft, of which 0.39 ft is chargeable to dredging in the St. Clair River. Data somewhat at variance with this latter figure were given in "Comparison of Levels in Lakes Michigan-Huron and Lake Erie" (Transactions, Vol. 95) by the late F. G. Ray, M. Am. Soc. C.E. Mr. Ray indicated that the evidence up to that time (1929) was not conclusive and that the record of additional years of high water would "afford safer and surer conclusions." Messrs. Pettis and Moore state "that there may have been a further lowering of the levels of Michigan-Huron within the last few years." Apparently, further records and investigations are required before we can be sure just what the long-time effects will be of the hydraulic changes that have been made in the St. Clair River, and just how much "compensation" will be necessary to restore the natural levels.

What is meant by "natural levels"? Presumably, those that prevailed before man disturbed the natural regimen, or before 1900 and back to 1860. If by compensating works we restore such levels in low water, and then experience a return of the high water of 1838, the resulting lake levels would be higher than those of 1838—probably injuriously high. If compensation is useful to navigation its usefulness is limited to low-water years, but the construction of compensating works during low-water years, as the authors point out, penalizes the downstream lakes and channels.

The Lake Survey is to be highly commended for its experiments with submerged sills. It is of interest to note that a vertical upstream face is more effective than a vertical downstream face. But other proportions should not be neglected. It would appear that the higher the sill in relation to its width, the greater its effectiveness, and hence that the maximum loss would be produced by a line of sheet-piling. Of course, a departure from the rock-pile type of construction introduces complexities. Perhaps staggered piles of stone, in the shape of frustums of cones, might well receive consideration.

In spite of the excellent experimental work, one is impressed by the fact that the solution is not obvious. One may also question the quantitative predictions from small model studies. If the effects of any project should overshoot the mark, more injury than benefit might result. Compensation, if attempted, might well be undertaken gradually, using the river itself as the testing flume.

The authors indicate that Canada may some day divert 10,000 cu ft per sec from the Hudson Bay drainage into Lake Superior and conclude that if this should be done, "the construction of compensation works would be both unnecessary and undesirable." The fact that Canada desires to reserve such a right might indicate a serious possibility in this direction, though the best information a few years ago was that any such proposition was economically impracticable.

I am still firmly of the conviction that the solution will ultimately

be found in regulation rather than in compensation, whether that regulation aims primarily at a reduction in fluctuations of levels or at the maintenance of the maximum uniformity of flow. Obviously, the difficulties are great; puzzling engineering problems are involved; the economic interests of navigation and water power need to be reconciled; and the political interests of two nations, several states, and numerous cities must be satisfied.

It is apparent that conditions do not yet force the consideration of any control. But some day the St. Lawrence River will be developed for navigation and power, and larger boats will demand a channel to Duluth. It is to be hoped that when that day comes, the conflicting interests will be reconciled and some form of regulation installed. Meanwhile, studies of all the aspects of this problem should be carried on unremittingly.

LOUIS E. AYRES, M. Am. Soc. C.E.
Consulting Engineer

Ann Arbor, Mich.
December 1, 1937

Subsurface Utility Planning in St. Paul

TO THE EDITOR: The paper by H. H. Kranz, M. Am. Soc. C.E., in the October issue, sets forth in concrete form suggestions as to standards of practice for underground utility planning, which will be helpful to all engineers called upon to cope with this problem. While there has been no subsurface planning agency in St. Paul, the utility companies have lately cooperated with the city in planning extensions and betterments.

In recent years city engineering departments have been generally pressed for sufficient funds to keep standard records up to date, to say nothing of additional duties. Utility companies will unquestionably contribute voluntarily to the work of a subsurface planning agency by furnishing data and records. Further contribution for maintenance of a municipal underground planning and record bureau would probably have to be included in franchise agreements. Inasmuch as the establishing and continuance of a complete underground record is a major undertaking, the financing of such an operation will in many cities be, for the present at least, an important consideration.

Where extensive street improvements requiring relocation, replacement, or enlargement of utility structures are contemplated, these should be planned with care and constructed in advance so as to eliminate as far as practicable the necessity of cutting pavements for at least ten years. Ducts for street lighting, traffic control signals, police and fire alarm systems, and similar utilities should also be placed in advance of such improvements.

The use of tunnels in St. Paul has been mentioned in Mr. Kranz's paper. It is not my purpose to enter into a discussion of the relative economy of utility tunnels as against open-cut utility structures. The use of utility tunnels in St. Paul has arisen mainly from existing geologic formations. Approximately one-half the loop district is built on limestone 8 to 12 ft in thickness, over which even in the natural state there was not more than 2 ft of overburden and below which is the deep St. Peter sandstone formation, which can easily be tunneled and which will remain for long periods of time without lining, except in sewer and heat-main tunnels. The city water department has for many years consistently utilized the zone immediately underlying the limestone. Piece-meal construction of sewers and of power, heat, and telephone conduits by the several utility companies organized in the early days, and the two telephone companies since merged, have resulted in extremely irregular uses. Even with the disadvantage of the present system due to lack of coordination in the beginning, the maintenance cost of cable, heat mains, and water mains is extremely low because of easy access.

Although no special plan may have been adopted, many cities have for a number of years followed, with certain modifications, fixed schedules for the location of utility structures. In St. Paul except in the case of intercepting or relief sewers, the sewer occupies the center of the street. Gas mains occupy the south and east sides, and water mains the north and west sides of each street. Before making cuts in the street the utility company, or water department, is required to take out a permit from the department of public works. The utility company is permitted to make the cut, to backfill the trench after the work is completed, and to place the concrete base where there is pavement. The city then replaces the pavement surface on the basis of a fixed schedule of prices.

A complete record of underground structures is the best basis for present and future planning. Even though it is not possible for a city engineer to assemble such records at once, it is evident that they should be accumulated and, as time and finances permit, worked into permanent form.

GEORGE M. SHEPARD, M. Am. Soc. C.E.
Chief Engineer, Department of Public Works

St. Paul, Minn.
December 6, 1937

Chanute Gliders

TO THE EDITOR: The accompanying photographs may be of interest to your readers as a supplement to the biographical sketch of Octave Chanute that appeared in the December issue. One of them shows a Chanute quadruplane glider of 1896, and the other a Chanute biplane glider of 1900. The pictures are from the files of the U. S. National Museum.

J. E. GRAF
Associate Director,
U. S. National Museum

Washington, D.C.
December 7, 1937

U. S. National Museum

TWO OF THE GLIDERS THAT HELPED PREPARE THE WAY FOR POWERED FLIGHT

Place of the Modern Express Highway

To the Editor: I should like to comment on the article by John S. Crandell, M. Am. Soc. C.E., in the October issue of Civil Engineering. The place of the express highway in a modern road system must, in the final analysis, be determined by its economic justification.

In January 1932, the United States had a total of 3,790 miles of extra-wide highways in our state systems, exclusive of the mileage of city streets and parkways. By extra-wide highways is meant those highways having more than two lanes. There were 2,230 miles of three-lane width, 1,385 miles of four-lane width, and 175 miles of five-lane, six-lane, and over.

Five years later (bringing these data up to July 1, 1937), there is a total of 7,999 miles of important highways exceeding two-lane widths, of which 4,703 miles are three-lane, 3,096 four-lane, and 201 five-and six-lane. The fact that the mileage of extra-wide highways on our state systems has been more than doubled within five years is significant of the trend in highway construction. Within that same period the real planning of modern highway systems has been given exhaustive study, using the basic assumption that our highways should be planned to do the greatest good for the greatest number.

The main question raised by Professor Crandell seems to me to be whether or not express highways should connect our centers of population with slabs of equal width in extra lanes. Is there economic justification for this idea? Resolving this interstate problem of connecting our national centers into a local state problem and taking the state of Missouri as an example—Route U. S. 40 extends from the city limits of St. Louis to those of Kansas City, a distance of 251.7 miles; U. S. 50 extends from the city limits of Kansas City to the city limits of St. Louis, a distance of 256.9 miles. According to a traffic study for 1936, our annual average 24-hour traffic shows approximately 6,000 cars a day a few miles outside St. Louis, and about 3,500 cars per day a few miles outside Kansas City, with varying volumes along these routes, ranging from an average of 1,000 to 2,000 vehicles per day, ebbing and flowing at the towns and cities studding the highways. On a certain day, on one road just outside the city limits of St. Louis, there was recorded a volume of 33,660 vehicles, with an average flow at the city limits of from 10,000 to 12,000 cars.

Let us compare traffic flow to the distribution of water. The largest pipes are next to the reservoir, or source of supply. As the water is carried to various sections, the size of the pipes is lessened in deference to the demand for water by the consumers. It is a self-evident fact that the pressure of traffic is from the centers of congestion in metropolitan areas outward, just as in the case of the distribution of water from a reservoir.

Traffic-flow maps invariably show that traffic demands wider traffic-ways near centers of population. The same maps also show that two-lane highways are sufficient to take care of traffic needs a reasonable number of miles away.

It is my opinion that the state traffic surveys now being completed and analyzed will definitely show where express highways should be located, and that while there may not be economic justification for the construction of an express highway now, it is certainly is good planning to acquire land for the subsequent building of these roads when and if the need arises.

We do need express highways to take care of the outward pressure of traffic from our large cities. I cannot agree that we need express highways up and down our land where the traffic itself cannot show economic justification. I do agree most emphatically that we must plan to secure sufficient right of way to add additional lanes to take care of future traffic demands.

If it is desirable to improve a small percentage of our highway system as express highways, let us realize that, from the standpoint of economic justification, the place of an express highway in a modern road system is to take care of the outward pressure of traffic from our metropolitan areas, in so far as this extra pressure exists and not to serve as a continuous superhighway connecting centers of population.

Robert B. Brooks, M. Am. Soc. C.E.
Consulting Engineer

St. Louis, Mo.
December 2, 1937

Cross-Sectional Dimensions of Reichsautobahnen

To the Editor: I wish to give the correct figures on the Reichsautobahnen design which John S. Crandell, M. Am. Soc. C.E., mentions in his article on "The Express Road and the Highway System," in the October 1937 issue of Civil Engineering.

The total width of this highway is 24 m (78.7 ft). The highway is divided into four lanes, each 3.75 m (12.3 ft) wide, and a middle strip, 5 m (16.4 ft) wide, with 2-m (6.6-ft) shoulders on each side—half of it paved. The cross-sectional dimensions of the Reichsautobahnen are shown in the accompanying Fig. 1. There are no bicycle paths on the Reichsautobahnen.

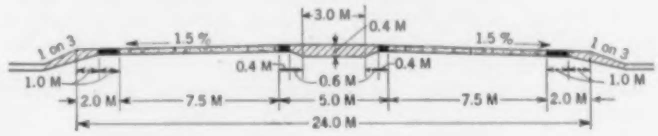


Fig. 1. Cross-Section Showing Dimensions (in Meters) of the Reichsautobahnen

The bridges on this highway are as light as it was possible to make them in concrete for the existing wheel loads. The concrete slabs are 8 in. thick, the 1937 type being 1 in. thicker because the reinforcement is left out. There is no macadam base below the slabs.

Ernst W. Goerner, Assoc. M. Am. Soc. C.E.

Berlin, Germany
November 23, 1937

Which Is Largest Tunnel?

To the Editor: A salient characteristic of the American is a disposition to boast in terms of superlatives. No observation, no accomplishment can be described in cold blood, for whatever it may be worth, leaving its evaluation to readers or hearers. It must be dramatized—it must be the "first," or the "longest," or the "tallest," or the "worst"—it matters not so long as there is nothing more beyond. If, as is so often the case, the affair in hand is hopelessly ordinary, resort is had to the trick of creating a new class, or of limiting the area considered. It is the "tallest building painted blue between Keokuk and Kankakee"; or the "shortest time from San Francisco to Shanghai ever made by a single-screw steamer 300 ft long."

This form of appeal for the applause of the gaping multitude is, at the best, merely vulgar—unbecoming to any man of scientific or professional pretensions, except he be a professional politician. When, however, such claims are made without verification of their validity, the claimant makes himself ridiculous, and his right to the attention of serious-minded men is put in question.

Within the past year the San Francisco–Oakland Bay Bridge has been described several times in print and by means of sound-motion pictures. All these accounts have included the statement that the connecting tunnel on Yerba Buena Island has the largest cross-section among the tunnels of the world. This may be classed as unimportant if true, since the length of the tunnel is only about one city block and is less than ten times its width. However, the dimensions given do not bear out the truth of the claim.

The Rove tunnel of the Rhone-Marseille canal has a height of 15.40 m, and a width of 22 m, both measured inside the lining. The lining has a minimum thickness of 1 m, and in places exceeds 1.5 m. The tunnel is 7.12 km long. Work on it, begun in 1911, was interrupted by the war, but the headings were holed through in February 1916. Work on the lower or canal section was so far advanced in 1923 that operation in 1925 was anticipated. Since this tunnel was built outside the United States, it was perhaps considered unworthy of attention by our more or less technical press.

The San Francisco–Oakland Bay Bridge has sufficient claim to distinction without resorting to incorrect statements or to ballyhoo about insignificant features.

Charles W. Comstock, M. Am. Soc. C.E.

Jackson Heights, N.Y.
November 25, 1937

Computing Settlement Stresses

TO THE EDITOR: In a letter in the November issue of CIVIL ENGINEERING, Alfred Africano, Jun. Am. Soc. C.E., discusses the writer's article on "Settlement Stresses Found with a Model," in the August issue. In this discussion he calls attention to glaring discrepancies between the results given and those obtained by the engineers of the Interborough Rapid Transit Company in their analysis of one of the bents of the Corona Yard car shed.

Any stress analysis using for its starting point the deformed shape of a structure is valid only as long as the material used is not strained beyond the limit of proportionality, which for practical purposes may be taken at the yield point. If overstrained, the structure will be more or less plastically deformed, the member carrying the highest stress yielding first.

On account of the irregular resistance offered by materials at the yield point, the amount of plastic yielding is unpredictable, but in a fixed-ended or anchored structure the overstraining of one member generally brings about a redistribution of stresses, which process may have the effect of limiting the yielding.

This is just what seems to have happened to the bent referred to by Mr. Africano, since the deflection measurements on which the Interborough Rapid Transit Company engineers have based their calculations are not consistent with the problem in hand, as is proved by the need of an external force to balance the structure.

From the relative base movements, $a = -1/8$ in., $b = +7^3/_4$ in., $c = +1$ in., $d = +6^3/_4$ in., the reactions are easily computed by means of Table II in my article and are found to be as follows (values in inch and kip units):

$$H_1 = -13.3 \qquad H_2 = -1.3 \qquad H_3 = -15.5$$
$$V_1 = +24.1 \qquad V_2 = -40.5 \qquad V_3 = +18.8$$
$$M_1 = -1{,}110 \qquad M_2 = -323 \qquad M_3 = -1{,}281$$

These values give for the column moment m at the lower end of the knee brace (Fig. 5 *b*, of my article):

$$m_1 = -1{,}110 + 13.3 \times 177 = +1{,}240$$
$$m_2 = -323 + 1.3 \times 177 = -93$$
$$m_3 = -1{,}281 + 15.5 \times 201 = +1{,}835$$

The section modulus S and effective column area A being, respectively,

$$S_1 = 68.8 \qquad S_2 = 50.3 \qquad S_3 = 64.5$$
$$A_1 = 20.5 \qquad A_2 = 13.7 \qquad A_3 = 24.6$$

we have for the maximum combined stress f due to displacement of the footings:

$$f_1 = 19 \qquad f_2 = 5 \qquad f_3 = 29$$

To these values are still to be added the load stresses. These may run as high as 16 or 18 kips per sq in., showing that the theoretical stress in Column C_3 may exceed 45 kips per sq in.

Had Column C_3 been made of high tensile steel it would probably have resisted this stress. However, as the material is mild steel, the stress cannot rise above 33 kips per sq in. until the horizontal portion of the stress-strain curve at the yield point has been passed. Until this takes place, the overstrained portion of the column will behave toward the unbalanced excess force as a hinge, while the column, no longer sufficiently restrained by the knee brace, will suffer an additional deflection to the right, carrying the roof members with it.

The force responsible for this movement is the sum of the horizontal reactions at the foot of Columns C_1 and C_2, initially amounting to about 15 kips. Transmitted through the roof members, the force would have been resisted by the equal and opposite reaction at the foot of Column C_3, but for the failure of the latter. If the column had been strong enough, its upper end, according to model measurements, would have been deflected about $^5/_8$ in. to the left, instead of $^3/_8$ in. to the right. The plastic deflection has, therefore, been about 1 in.

The distortion of the bent may also be explained by assuming that the footings, in addition to their translatory movement, have also sustained a tilt. Since this condition, however, was not covered by the article, it will not be discussed beyond stating that in such an event the structure is not necessarily overstrained.

ANDERS BULL, M. Am. Soc. C.E.
Assistant Engineer, Board of Transportation of the City of New York

New York, N.Y.
November 12, 1937

Timber a Renewable Crop

TO THE EDITOR: In his excellent article on "Social Horizons of the Engineer," in the November issue, Harry J. Engel, Jun. Am. Soc. C.E., makes comparisons of the status of certain resources of the United States, which tend to give the reader an erroneous conception of the timber resources of the country. With the exception of timber, all the raw materials on his chart (Fig. 1) require such a large span of years for physical formation that they may well be regarded as irreplacable.

On the other hand, timber should be regarded as being by nature a renewable crop—not a mine. Timber grows, ripens, and declines as other crops. If it is not harvested, it outlives its usefulness as saw timber and disintegrates—that is, it is lost through disuse. The casual observer of logging operations frequently forms the false impression that appalling waste attends present practices until he discovers that a large percentage of the trees have lost their economic value through over-maturity.

The extent of our timber resources is usually underestimated. The present stand of saw timber, suitable for sawing today, on the commercial saw timber areas of the United States is 1,668 billion fbm—which agrees with the 24 per cent of 7 trillion in Mr. Engel's Fig. 1. This represents only 189 million acres of the present commercial forest area of 495 million acres. The gross average yearly drain of saw timber during the 6-year period, 1929 to 1934, was 34.1 billion fbm, of which 19.8 billion was saw timber, 9.8 billion other forest products, and 4.5 billion lost through fires, insects, and other causes. The current annual growth of saw timber on these 189 million acres is 11.7 billion fbm. This leaves a net drain of 22.4 billion fbm per year. (Young stock below saw timber size is not considered in saw timber inventories.)

Even on the present basis of procedure, the present supply of lumber will last 74 years. In fact, it is authoritatively estimated that, after removal of the present virgin timber and with certain improvements in forest management, the annual growth on the same area will exceed 25.2 billion fbm, with a net annual drain of only 8.17 billion fbm, thereby providing a supply for 204 years.

Before the expiration of 204 years and if sound forest practice provisions such as were provided in the Code were carried out in the meantime, it can be confidently expected that the forest ledger will be permanently balanced with respect to supply and demand. It must also be remembered that, in addition to the 189 million acres of saw timber area just considered, there are 306 million acres of commercial forest area in various stages of timber growth.

The present trends are very definitely towards forestation of additional acreage, better fire control, and better silvicultural practices. For example, it is now customary to leave patches of standing trees at predetermined periodic intervals until the surrounding cut-over area has been seeded by the wind. Some of the large saw mills are set up on a permanent basis with the expectation that, after the first cutting is completed, a new crop of timber will be available on the land previously cut.

Admittedly, during the colonial and expansion periods of our country, enormous quantities of saw timber were wasted. As a matter of fact, it has been estimated that approximately two-fifths of the 7 billion fbm shown on Mr. Engel's chart were destroyed through burning and other means to make way for agriculture. Many early loggers thought of our timber resources as a mine rather than as a crop, and therefore made little or no provision for reforestation. Later, more mature thought was given to these resources. The modern viewpoint, which regards timber as a crop, together with technical developments in reforestation, forest management, and the processing and utilization of forest products, has largely reduced or eliminated the abuses of the past. However, we must remember that since saw timber is subject to the same economic laws of supply and demand as other articles of commerce, it will increase in abundance only to the extent that utilization makes commercial timber growing a business for profitable investment.

The figures that I have given are taken from *Economic Problems of the Lumber and Timber Products Industries*, published by the office of the National Recovery Administration (March 1936). This is recognized as the most complete and authoritative study of the industry.

FRANK J. HANRAHAN, Assoc. M. Am. Soc. C.E.
Structural Engineer, National Lumber Manufacturers Association

Washington, D.C.
November 22, 1937

Eighty-Fifth Annual Meeting

New York, N.Y., January 19–22, 1938

Program of Sessions, Entertainment, and Trips

Business Meeting, Conferring of Honorary Membership, and Prize Awards

WEDNESDAY—January 19, 1938—Morning

AUDITORIUM

9:00 **Registration**

10:00 **Eighty-Fifth Annual Meeting called to order by**

LOUIS C. HILL, *President, American Society of Civil Engineers; Consulting Engineer*, Los Angeles, Calif.

Report of the Board of Direction

Report of the Secretary

Report of the Treasurer

10:30 **Conferring of Honorary Membership**

GEORGE S. DAVISON, *Past-President, Am. Soc. C.E., President, Davison Coke and Iron Company*, Pittsburgh, Pa. Mr. Davison will be presented to the President by ROBERT RIDGWAY, *Past-President and Hon. M. Am. Soc. C.E., Consulting Engineer*, New York, N.Y.

OTIS E. HOVEY, *M. Am. Soc. C.E., Director, Engineering Foundation; Consulting Engineer*, New York, N.Y. Mr. Hovey will be presented to the President by DR. JOHN P. BROOKS, *President Emeritus of Clarkson College of Technology*, Potsdam, N.Y.

The late HUNTER McDONALD, *Past-President, Am. Soc. C.E.*, Nashville, Tenn. Statement on the achievements of Mr. McDonald will be made by ARTHUR J. DYER, *M. Am. Soc. C.E., President, Nashville Bridge Company*, Nashville, Tenn.

J. R. WORCESTER, *M. Am. Soc. C.E., Consulting Engineer*, Boston, Mass. Mr. Worcester will be presented to the President by CHARLES R. GOW, *M. Am. Soc. C.E., President, Warren Brothers Company*, Cambridge, Mass.

11:00 **Presentation of Society Medals and Prizes**

The Norman Medal to J. C. STEVENS, *M. Am. Soc. C.E., Consulting Hydraulic Engineer*, Portland, Ore., for Paper No. 1927, "The Silt Problem."

The J. James R. Croes Medal to INGE M. LYSE, *M. Am. Soc. C.E., Research Professor of Engineering Materials; In charge, Fritz Laboratory, Lehigh University*, Bethlehem, Pa., and BRUCE G. JOHNSTON, *Assoc. M. Am. Soc. C.E., Instructor, Civil Engineering, Columbia University*, New York, N.Y., for Paper No. 1941, "Structural Beams in Torsion."

The Thomas Fitch Rowland Prize to EUGENE A. HARDIN, *M. Am. Soc. C.E., Assistant Civil Engineer, Department of Public Works*, Detroit, Mich., for Paper No. 1929, "The Springwells Filtration Plant, Detroit, Michigan."

The James Laurie Prize to BORIS A. BAKHMETEFF, *M. Am. Soc. C.E., Professor of Civil Engineering, Columbia University*, New York, N.Y., and ARTHUR E. MATZKE, *Jun. Am. Soc. C.E., Research Assistant, Department of Civil Engineering, Columbia University*, New York, N.Y., for Paper No. 1935, "The Hydraulic Jump in Terms of Dynamic Similarity."

The Arthur M. Wellington Prize to E. C. HARWOOD, *Captain, Corps of Engineers, U.S.A., Retired;* Director, *American Institute for Economic Research*, Cambridge, Mass., for Paper No. 1953, "Proposed Improvement of the Cape Cod Canal."

The Collingwood Prize for Juniors to VICTOR L. STREETER, *Jun. Am. Soc. C.E., Assistant Engineer, U. S. Bureau of Reclamation*, Denver, Colo., for Paper No. 1936, "Frictional Resistance in Artificially Roughened Pipes."

The Rudolph Hering Medal to F. L. FLYNT, *Assoc. M. Am. Soc. C.E., Principal Engineering Aide, Hydraulic Section, U. S. Engineer Office*, Rock Island, Ill., and W. W. HORNER, *M. Am. Soc. C.E., Consulting Engineer; Professor, Municipal and Sanitary Engineering, Department of Civil Engineering, Washington University*, St. Louis, Mo., for Paper No. 1926, "Relation Between Rainfall and Runoff from Small Urban Areas."

Business Meeting

New Business

Report of Tellers on Canvass of Ballot for Officers

Introduction of President-Elect and New Officers

Luncheon

Fifth floor, Engineering Societies Building. Tickets $1.00 each.

Assist the Committees by Registering and Obtaining Tickets Early

General Meeting, Student Conference, President's and Honorary Members' Dinner, Reception, and Dance

WEDNESDAY—January 19, 1938—Afternoon

SYMPOSIUM ON NATIONAL DEPARTMENT OF PUBLIC WORKS

Auditorium

2:30 **History of Movement to Establish a Federal Department of Public Works**

ALONZO J. HAMMOND, *Past-President, Am. Soc. C.E., Consulting Engineer,* Chicago, Ill.

3:00 **Reasons for a Department of Public Works**

GEORGE W. BURPEE, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y.

3:30 **Some Factors Influencing the Establishment of a Department of Public Works**

DONALD H. SAWYER, *M. Am. Soc. C.E., Chief, Section of Space Control, Procurement Division, Treasury Department,* Washington, D.C.

4:00 **Discussion**

STUDENT CHAPTER CONFERENCE

Fifth Floor

3:00 **Conference of Student Chapter Representatives Will Be Held on the Fifth Floor, Engineering Societies Building**

Under the sponsorship of the Society's Committee on Student Chapters, and managed by the Conference of Metropolitan Student Chapters, a general student conference will be held on the fifth floor of the Engineering Societies Building beginning at 3:00 p.m.

The program has been prepared by students and will include a brief address of welcome with a response, a short address by an officer of the Society, two 12-minute papers by students, an address by a member of the Society, and student discussion on a few topics.

The conference is to be concluded by 5:00 p.m. and will be followed by a light collation and smoker. All students, members, and others interested will be welcome.

Dinner, Reception, and Dance

WEDNESDAY—January 19, 1938—Evening

Hotel Waldorf-Astoria

Committee: E. W. STEARNS, *Chairman;* EDWARD P. PALMER, and EMIL PRAEGER

7:00 **Assembly**

7:45 **Dinner**

9:30 **Reception to the President and Honorary Members**

10:00 **Dancing**

This function will be held in the Grand Ball Room of the Hotel Waldorf-Astoria, Park Avenue and 50th Street. Dinner will be served promptly at 7:45 p.m.

Arrangements have been made for tables seating ten persons, and members may underwrite complete tables. Orders to underwrite a table must be accompanied by check in full and a list of guests.

Tickets will be $5.00 each. Tickets for Juniors, for the dance only, will be $2.00 per couple.

The seating list for the dinner dance will close at 5:00 p.m., Tuesday, January 18, 1938. Those who purchase tickets after that hour will be assigned to tables in the order of purchase. Tickets will be on sale at Society Headquarters until 5:00 p.m., Wednesday, January 19, 1938.

FRONT VIEW OF NEWARK TERMINAL—ONE OF THE PLACES TO BE INSPECTED ON THE FRIDAY EXCURSION

Sessions of Technical Divisions Occupy Entire Day

THURSDAY—January 20, 1938—Morning

POWER DIVISION

James W. Rickey, *Chairman, Executive Committee, Presiding*

SYMPOSIUM ON COST OF POWER

Continuing the policy that was started during the 1936 Pittsburgh Meeting, when the symposium on "Economic Aspects of Energy Generation" was arranged jointly by the Power and the Engineering-Economics and Finance Divisions, the Power Division through its Committee on Power Cost arranged the symposium on "Cost of Power."

The Pittsburgh (first) symposium covered the ground in so far as general principles are concerned. It is expected that the (second) symposium on "Cost of Power" will be a logical continuation, but with particular emphasis on factual data. The Power Division intends to arrange a third symposium on the "Ultimate Cost of Power to the Consumer," which should consider, among other problems, the distribution problem; therefore the main purpose of the second symposium is to consider the cost of delivered energy, say, on the high tension bus of the distribution substation.

The desired objective is to develop properly balanced symposiums of considerable interest and to present papers and discussions of such importance that they can be used in the future in formulating definite conclusions and perhaps even recommendations.

In the Pittsburgh symposium economists were invited to present the two closing papers. In the New York symposium all papers will be presented by engineers, but arrangements are made to have the closing paper discussed by outstanding economists.

9:30 **Opening Remarks**
James W. Rickey, *M. Am. Soc. C.E., Consulting Engineer, Aluminum Company of America,* Pittsburgh, Pa.

9:40 **Elements of Power Cost**
John C. Page, *M. Am. Soc. C.E., Commissioner, U. S. Bureau of Reclamation,* Washington, D.C.

10:10 **Discussion opened by**
Daniel W. Mead, *Past-President and Hon. M. Am. Soc. C.E., Professor Emeritus, Hydraulic and Sanitary Engineering, University of Wisconsin; Consulting Engineer,* Madison, Wis.

10:25 **Cost of Heat-Generated Energy**
Dr. C. F. Hirshfeld, *Chief of Research, The Detroit Edison Company,* Detroit, Mich.

10:55 **Discussion opened by**
A. G. Christie, *Professor of Mechanical Engineering, Johns Hopkins University, Baltimore, Md.*

11:10 **Cost of Hydro-Generated Energy**
H. K. Barrows, *M. Am. Soc. C.E., Professor of Hydraulic Engineering, Massachusetts Institute of Technology; Consulting Engineer,* Boston, Mass.

11:30 **Discussion opened by**
L. N. McClellan, Esq., *Chief Electrical Engineer, U. S. Bureau of Reclamation,* Denver, Colo.
T. B. Parker, *M. Am. Soc. C.E., Chief Construction Engineer, Tennessee Valley Authority,* Knoxville, Tenn.

SANITARY ENGINEERING DIVISION

Harry E. Miller, *Chairman, Executive Committee, Presiding*

10:00 **Presentation of Reports of Division Committees**

(1) **Committee on Water Supply Engineering**
Thomas H. Wiggin, *M. Am. Soc. C.E., Consulting Engineer,* New York, N.Y., *Chairman.*

(2) **Committee on Technical Aspects of Refuse Disposal**
Harrison P. Eddy, Jr., *M. Am. Soc. C.E.; Consulting Engineer,* Boston, Mass., *Chairman.*

(3) **Discussion of Vinson Bill and Other Proposed Legislation Affecting Stream Pollution**

STRUCTURAL DIVISION

Eugene L. Macdonald, *Chairman, Executive Committee, Presiding*

10:00 **Report on Fatigue Tests of Riveted Joints**
Wilbur M. Wilson, *M. Am. Soc. C.E., Research Professor of Structural Engineering, University of Illinois,* Urbana, Ill.

10:45 **Report of Committee on Masonry and Reinforced Concrete**
Hardy Cross, *M. Am. Soc. C.E., Professor of Civil Engineering, Yale University,* New Haven, Conn., *Chairman.*

11:00 **Summary of Paper by Messrs. Harold E. Wessman and Shortridge Hardesty on Preliminary Designs of Suspension Bridges**
Harold E. Wessman, *Assoc. M. Am. Soc. C.E., Professor of Structural Engineering, College of Engineering, New York University,* New York, N.Y.

11:15 **Discussion**

View of Hendrik Hudson Bridge and Parkway

CITY PLANNING DIVISION

Harold M. Lewis, *Chairman, Executive Committee, Presiding*

10:00 **Aspects of the National Resources Committee's Urbanism Study of Interest to Civil Engineers**
L. W. Segoe, *M. Am. Soc. C.E., Consulting Engineer and City Planner,* Cincinnati, Ohio; *and Director of the Urbanism Committee.*

The Functions of Planning Commissions in Cooperation with Public Housing Authorities
Presented from Four Points of View:

10:30 William J. Fox, *Assoc. M. Am. Soc. C.E., Chief Engineer, Regional Planning Commission,* Los Angeles County, Los Angeles, Calif.

10:50 Theodore T. McCrosky, *Assoc. M. Am. Soc. C.E., Planning Director, City Planning Commission,* Yonkers, N.Y.

11:10 Louis H. Pink, *Chairman, New York State Housing Board; former Member, New York City Housing Authority,* Kew Gardens, N.Y.

11:30 Joseph Nevin, Esq., *Staff of New Jersey State Housing Authority,* Newark, N.J.

11:50 **General Discussion**

Sessions of Technical Divisions (*Continued*)

THURSDAY—January 20, 1938—Afternoon

POWER DIVISION

JAMES W. RICKEY, *Chairman, Executive Committee, Presiding*

Symposium on Cost of Power (Continued)

2:00 **Cost of Combined Energy Generation**

EZRA B. WHITMAN, *M. Am. Soc. C.E., Consulting Engineer*, Baltimore, Md.

2:30 **Discussion opened by**

H. G. GERDES, *M. Am. Soc. C.E., Engineer, Federal Power Commission*, Washington, D.C.

PHILIP SPORN, *Esq., Vice-President and Chief Engineer, American Gas and Electric Company*, New York, N.Y.

2:50 **Cost of Depreciation and Obsolescence in Energy Generation**

MAURICE R. SCHARFF, *M. Am. Soc. C.E., Consulting Engineer*, New York, N.Y.

3:10 **Discussion opened by**

DR. JAMES C. BONBRIGHT, *Professor of Finance, Columbia University*, New York, N.Y.

3:25 **Closing Paper—Cost of Power**

W. F. UHL, *M. Am. Soc. C.E., Hydraulic Engineer, Chas. T. Main, Inc.*, Boston, Mass.

3:55 **Discussion opened by**

DR. LEVERETT S. LYON, *Executive Vice-President, The Brookings Institution*, Washington, D.C.

DR. JOHN T. MADDEN, *Dean, School of Commerce, Accounts and Finance, New York University*, New York, N.Y.

4:25 **General Discussion**

STRUCTURAL DIVISION

EUGENE L. MACDONALD, *Chairman, Executive Committee, Presiding*

2:00 **The Application of Architectural Principles to Bridges**

WILBUR J. WATSON, *M. Am. Soc. C.E., Architect and Engineer*, Cleveland, Ohio.

2:30 **Discussion**

HIGHWAY DIVISION

LESLIE G. HOLLERAN, *Chairman, Executive Committee, Presiding*

2:30 **Provisions for Vehicular Traffic Within and Without the New York World's Fair**

JOHN P. HOGAN, *M. Am. Soc. C.E., Chief Engineer, New York World's Fair 1939, Inc.*, New York, N.Y.

3:00 **Discussion**

3:15 **Development Extension of Highways in Mexico**

SENOR RICARDO L. VAZQUEZ, *Director General of Roads, Mexico, D.F.*, Mexico.

3:45 **Discussion**

4:00 **Traffic Problems in Metropolitan Areas**

EARL J. REEDER, *Esq., Chief Traffic Engineer, National Safety Council, Inc.*, Chicago, Ill.

4:30 **Discussion**

SANITARY ENGINEERING DIVISION

HARRY E. MILLER, *Chairman, Executive Committee, Presiding*

2:30 **Air Sanitation**

EARLE B. PHELPS, *Esq., Professor of Sanitary Science, Columbia University*, New York, N.Y.

Discussion opened by

GORDON M. FAIR, *M. Am. Soc. C.E., Gordon McKay Professor of Sanitary Engineering, Harvard Graduate School of Engineering, Harvard University*, Cambridge, Mass.

3:30 **Sanitary Engineering Aspects of Industrial Hygiene**

J. J. BLOOMFIELD, *Esq., Sanitary Engineer, U. S. Public Health Service*, Washington, D.C.

Discussion opened by

THEODORE F. HATCH, *Associate Dust Control Engineer, Division of Industrial Hygiene, New York State Department of Labor*, New York, N.Y.

TRAFFIC STRUCTURE AT 79TH STREET ON THE NEW WEST SIDE IMPROVEMENT

Entertainment for the Ladies—Smoker for the Men

THURSDAY—January 20, 1938

Afternoon and Evening

FASHION SHOW, TEA, AND ENTERTAINMENT

Committee: Waldo G. Bowman, *Chairman;* E. Warren Bowden, A. L. Otto, and W. F. Scantlebury

3:15 **Fashion Show and Tea**

Through the courtesy of the management, the ladies will be entertained at Wanamaker's, Broadway at Ninth Street, where a special fashion show of smart clothes for daytime, active and spectator sports, and formal wear will be held.

Tea will be served following the show, and there will be music.

During the entire day, the Woman's Clubhouse at John Wanamaker's will be at the disposal of the ladies. The morning may be spent visiting Wanamaker's Winter Village, the Pine and Palm Shops, and other places of interest. Luncheon may be had at one of the store's three restaurants.

8:00 **Illustrated Address by Capt. John D. Craig, Explorer, Deep-Sea Diver, and Producer of Thrill Motion Pictures**

Seats have been reserved for ladies in the balcony of the Grand Ball Room of the Hotel Waldorf-Astoria for the address and motion pictures by Capt. John D. Craig.

Following the address, the ladies may remain in the balcony, where refreshments will be served.

Tickets to ladies for the evening's entertainment are $2.00 each.

Evening

SMOKER AND ENTERTAINMENT

Committee: Robert W. Sawyer, 3d, *Chairman;* E. A. Prentis, Arthur A. Collard, George L. Curtis, Chester L. Dalzell, Valentine E. Dyer, and James E. Ure

Place—Hotel Waldorf-Astoria, 50th Street and Park Avenue.

Time—8:00 p.m.

Speaker—Capt. John D. Craig, *Deep-Sea Diver and Explorer.*

As exploration and adventure have a particular appeal to engineers, the Society is fortunate in being able to present Capt. John D. Craig, nationally known explorer, deep-sea diver and producer of thrilling motion pictures.

Captain Craig's travels to obtain material for his lectures and thrill movies have taken him into 39 countries across five continents, and have extended from the arctic to the jungle as well as under the sea.

An expert deep-sea diver and an exhaustive student of ocean life, Captain Craig has developed two types of submarine motion-picture cameras. He is also an authority on big-game fishing and the habits and migrations of deep-sea fish, and his cameras have recorded the most remarkable films ever made of these subjects.

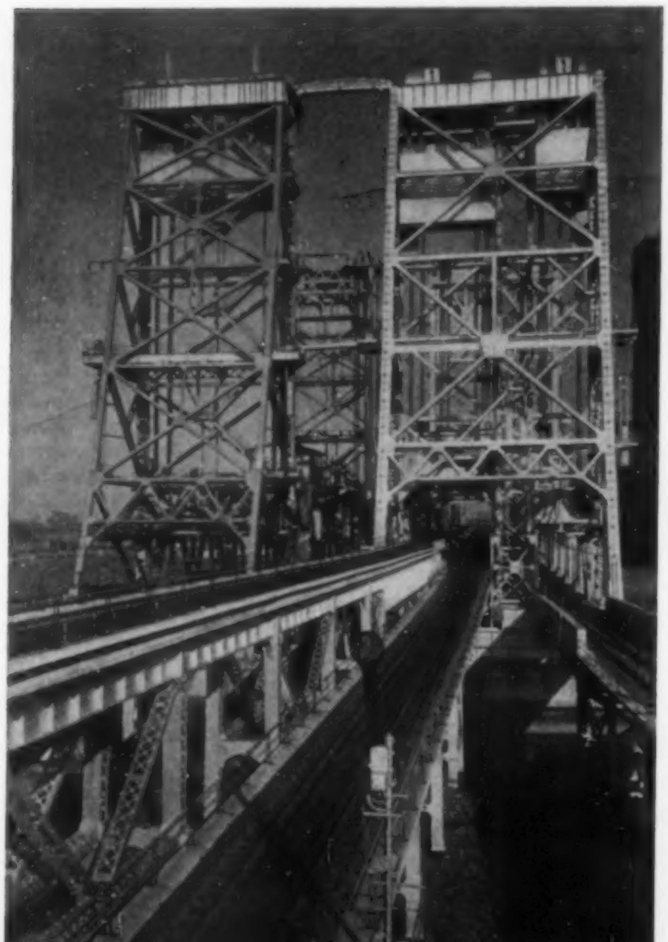
Following the lecture by Captain Craig, the remainder of the evening will be spent in good fellowship. There will be abundant smokes and refreshments.

Tickets for the Smoker and evening's entertainment are free to members. Guest tickets are $3.00 each.

View of Newark Terminal with Lift Spans in Background

Friday Excursion to Include Inspection of Bendix Aviation Corporation Development at Bendix, N.J., and Pennsylvania Railroad Terminal Improvements at Newark

Other Points of Interest Include Newly Opened Lincoln Tunnel Between New York and New Jersey; New Jersey Highway Approaches to Lincoln Tunnel; New Jersey Highways and Approaches to Holland Tunnel; Return via Holland Tunnel



INTRICATE LIFT SPANS—PART OF NEWARK TERMINAL IMPROVEMENT

FRIDAY—January 21, 1938—All Day

Committee: GLENN S. REEVES, *Chairman;* S. J. OTT and T. PATRICK QUILTY

10:00 Departure from Engineering Societies Building

Members, ladies, and guests will leave Society Headquarters, 33 West 39th Street, in heated buses promptly at 10:00 a.m.

On leaving Society Headquarters, the excursion will proceed directly to New Jersey via the newly opened Lincoln Tunnel. On the New Jersey side of the tunnel a stop will be made at the Weehawken Plaza to view the extensive approach connections.

Leaving the Weehawken approach, the excursion will follow the scenic route along Hudson County Boulevard to the top of the Palisades, where a view of the Manhattan skyline may be obtained, thence via New Jersey Highway Route 6 to the Bendix Aviation Corporation plant, now under construction at Bendix, N.J.

Bendix, recently named for Vincent Bendix, president of the corporation and sponsor of the annual transcontinental flying classic, was previously known as Teterboro, where some of America's best-known fliers had their base of operations.

It was at the Teterboro field that Anthony H. G. Fokker, famed Dutch plane designer, first began work in this country, and in his factory that Admiral Richard E. Byrd's north pole plane, the *Josephine Ford,* was built. The field was the first terminal for the New York–Boston air-mail-express service and also the first point from which regular air-mail service under government contract was started.

More than 500 acres of land, comprising the airport and adjacent ground, have been purchased or optioned, and after a long period of relative disuse will now contain the new plant and an improved airport. Four hundred acres will continue to serve as the airport, the remaining 100 acres being laid out for research and manufacturing buildings, with some space being allowed for future expansion.

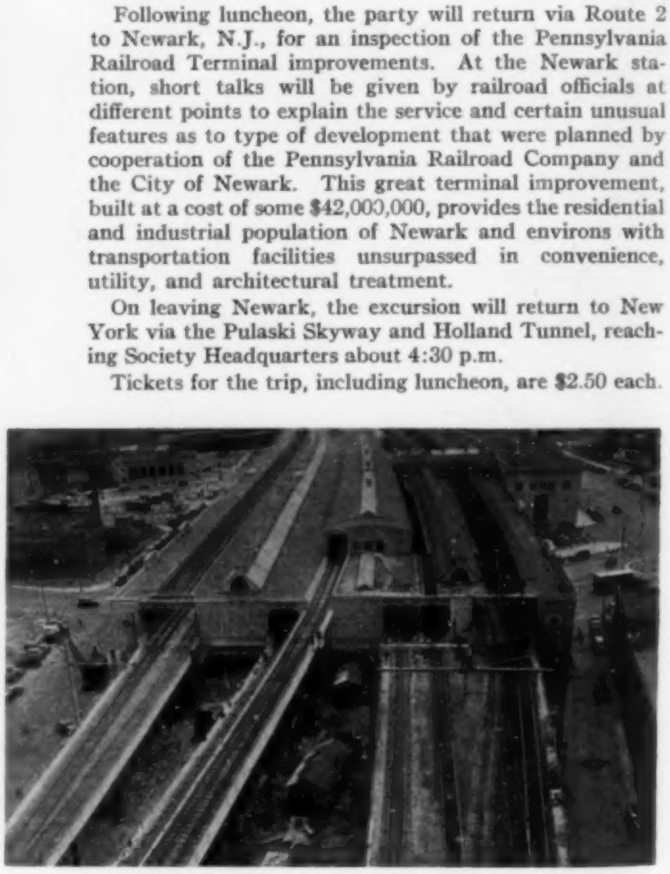
Approximately 385,000 sq ft of space will be contained in buildings devoted to administration, engineering, instruments, general and electrical manufacturing, foundry, heating plant, and warehouse.

Leaving Bendix, the excursion will proceed via Route 2 to the Swiss Chalet at Rochelle Park, where luncheon will be served.

Following luncheon, the party will return via Route 2 to Newark, N.J., for an inspection of the Pennsylvania Railroad Terminal improvements. At the Newark station, short talks will be given by railroad officials at different points to explain the service and certain unusual features as to type of development that were planned by cooperation of the Pennsylvania Railroad Company and the City of Newark. This great terminal improvement, built at a cost of some $42,000,000, provides the residential and industrial population of Newark and environs with transportation facilities unsurpassed in convenience, utility, and architectural treatment.

On leaving Newark, the excursion will return to New York via the Pulaski Skyway and Holland Tunnel, reaching Society Headquarters about 4:30 p.m.

Tickets for the trip, including luncheon, are $2.50 each.



EAST APPROACH TO NEWARK TERMINAL

College Reunions Throughout the Week

Alumni Gatherings Scheduled for Visiting Engineers

THURSDAY—January 20, 1938

Luncheon of Brown Engineering Association

The Brown Engineering Association will hold an informal luncheon meeting at the Hotel Bristol, 129 West 48th Street, New York, N.Y., on Thursday, January 20, 1938, at 12:30 p.m. All Brown alumni are invited. Please notify Mr. Sydney Wilmot, 33 West 39th Street, New York, N.Y. (Pennsylvania 6-9220, Ext. 54) as to attendance.

Luncheon of Chi Epsilon Honorary Civil Engineering Fraternity

Members of Chi Epsilon, their families and their friends, are again extended a cordial invitation to attend a very informal luncheon at the Midston House (Cornell Club Building), 22 East 38th Street, New York, N.Y., on Thursday, January 20, 1938, at 1:15 p.m.

Those interested should file advance notice with R. I. Land, 10th Floor, 100 East 42d Street, New York, N.Y. (Ashland 4-3300, Ext. 194), or H. T. Larsen, Room 1607, 33 West 39th Street, New York, N.Y. (Pennsylvania 6-9220, Ext. 87).

For the luncheon a charge of 90 cents per person will be made. It is hoped that as many Chi Epsilon members as possible, with their friends, will remember this date.

Lafayette College Civil Engineers' Dinner

All civil engineers of Lafayette College are invited to attend an informal dinner on Thursday, January 20, 1938, at 6:00 p.m., at Leeds Restaurant, 285 Madison Avenue (between 40th and 41st streets), New York, N.Y. If possible, come at 5:30 p.m. The charge will be $1.50 per cover. If you plan to attend, please notify William R. Wolff, 496 Hudson Street, New York, N.Y.

Lehigh University Alumni Dinner

A cordial invitation is extended to all Lehigh members of the Society to attend an informal dinner to be held at the Murray Hill Hotel, 112 Park Avenue, New York, N.Y., on Thursday, January 20, 1938, at 6:30 p.m. The dinner will cost $2.00.

Please promptly notify Alexander Potter, 50 Church Street, New York, N.Y., if you can be present.

The dinner this year will be held conjointly with the Lehigh Club of New York. Tom Girdler, Neil Carothers, and other speakers of national importance will be our guests.

Come directly to the hotel from your afternoon engagements. Society members and Lehigh Club members will be there as early at 5:30 p.m.

Luncheon of M.I.T. Engineers

All M.I.T. alumni are invited to a luncheon at the Technology Club of New York, on Thursday, January 20, 1938, at 12:30 p.m., at the club rooms, 22 East 38th Street, New York, N.Y. Please notify the Technology Club (Caledonia 5-1475) as to attendance.

Rensselaer Polytechnic Institute Dinner

There will be an informal dinner for Rensselaer men, their wives and guests, on Thursday, January 20, 1938, at 6:00 p.m., at the Building Trades Building, 2 Park Avenue (33d Street), New York, N.Y. The dinner will be over in ample time for participation in the Smoker or the ladies' entertainment. Reservations should be made with Glenn S. Reeves, The Port of New York Authority, 111 Eighth Avenue, New York, N.Y. The charge will be $1.35 per cover.

Syracuse University Alumni Dinner

Graduates and former students of the College of Applied Science of Syracuse University will hold a dinner at the Hotel Wentworth, 59 West 46th Street, New York, N.Y., at 6:30 p.m., on Thursday, January 20, 1938. Reservations at $1.50 per plate may be secured by writing Mr. S. F. Yasines, New York University, University Heights, New York, N.Y.

University of Illinois Engineers' Dinner

All University of Illinois engineers and their friends are invited to the Tenth Annual Informal Dinner-Reunion at the Hotel Woodstock, 127 West 43d Street, New York, N.Y., on Thursday, January 20, 1938, at 5:45 p.m., in the grill adjoining the main lounge. The dinner will cost $1.25 and will be over in time to attend the Society's Smoker. If you plan to attend, please notify M. N. Quade, 142 Maiden Lane, New York, N.Y. (John 4-1677).

University of Pennsylvania Civil Engineers' Dinner

The Nineteenth Annual Informal Dinner of the University of Pennsylvania Civil Engineers will be held at the University of Pennsylvania Club, 37 East 36th Street, New York, N.Y., on Thursday, January 20, 1938, from 6:00 to 7:00 p.m. The dinner fills in the time from the end of the technical session at 5:00 p.m. until the commencement of the Smoker at 8:00 p.m. Dinner will be served at 6:00 p.m. sharp, in the main dining room of the club.

The charge per cover will be $1.25. Any further information can be obtained from Albert B. Hager, care, Atlantic, Gulf and Pacific Company, 15 Park Row, New York, N.Y.

FRIDAY—January 21, 1938

Dinner of Columbia Engineers

The graduates of Columbia University who are members of the Society will meet for their seventeenth informal dinner on Friday, January 21, 1938, at 6:30 p.m., at the Columbia University Club, 4 West 43d Street, New York, N.Y. The guest of honor will be Ole Singstad, M. Am. Soc. C.E., Chief Engineer of the East River Tunnel, who will speak on "The Human Side of Engineering." The charge will be $1.50 per cover. Address communications to J. K. Finch, Columbia University, New York, N.Y.

Cornell Society of Engineers' Dinner

A dinner meeting of the Society will be held on Friday evening, January 21, 1938, at 6:30 p.m., at the Cornell Club of New York, 245 Madison Avenue, New York, N.Y. An interesting evening is anticipated.

Harvard-Yale-Princeton Joint Meeting

The Harvard Engineering Society will act as host at this year's joint meeting of the Harvard, Yale, and Princeton Engineering Associations, on Friday, January 21, 1938. The meeting will be held in the Museum of Science and Industry, Rockefeller Center, which has been reserved for the exclusive use of the Associations, and a number of special features will be included. Arrangements are also being made for a get-together buffet dinner nearby prior to the meeting. Full details will be mailed to all members by the respective secretaries.

New York University Annual Alumni Reunion Dinner

The annual reunion dinner for the alumni of New York University will be held at the Roger Smith Restaurant, 40 East 41st Street, New York, N.Y., on Friday, January 21, 1938, at 7:00 p.m. Come at 6:30 p.m. and enjoy a social period before dinner. Please send reservations to E. C. LaValley, New York University, Box 188, University Heights, New York, N.Y. Dinner will cost $1.50.

Thayer Society of Engineers of Dartmouth College

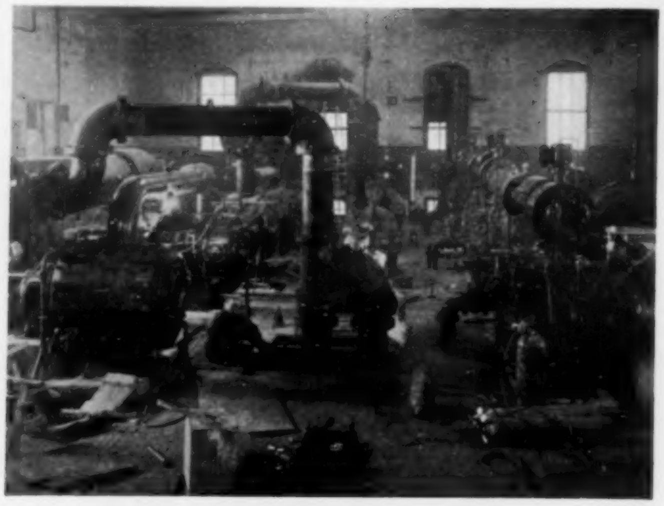
The annual meeting and dinner of the Thayer Society of Engineers of Dartmouth College will be held at the Dartmouth College Club, 30 East 37th Street, New York, N.Y., at 6:30 p.m., on Friday, January 21, 1938. Notify the Dartmouth College Club as to attendance.

SATURDAY—January 22, 1938

Clarkson College Alumni Dinner

The annual dinner of the Clarkson College Alumni Association will be held at the Building Trades Employers' Association Club, 26th Floor, 2 Park Avenue, New York, N.Y., on Saturday, January 22, 1938, at 6:30 p.m. There will also be an informal lunch and an afternoon meeting on the same day in the same place. Notify Frank C. Boes, 38 Cypress Street, Floral Park, N.Y., as to attendance.

SUBWAY CUT UNDER SIXTH AVENUE BETWEEN 45TH AND 46TH STREETS, SHOWING EXCAVATION WITH A MUCKING MACHINE



PART OF HUGE AIR-COMPRESSING PLANT ON QUEENS MIDTOWN TUNNEL—MANHATTAN SIDE

Trips to Points of Engineering Interest

SATURDAY—January 22, 1938—Morning

10:00 **Inspection Trips**

Arrangements have been made for visits to the following points of interest:

1. **Sixth Avenue Subway Construction**
2. **Midtown Tunnel Construction**
3. **West Side Park and Railroad Improvements**
4. **New York World's Fair Site**

As all the above trips start at the same hour, it will not be possible to participate in more than one. Members will proceed individually to the rendezvous point named for the trip that is selected, so as to arrive at the time given.

Attention of sanitary engineers is directed to the announcement elsewhere in the program of the inspection of the Wards Island Sewage Treatment Plant that has been arranged by the New York State Sewage Works Association and the Sanitary Engineering Division, through the courtesy of the New York Department of Sanitation.

SIXTH AVENUE SUBWAY CONSTRUCTION

The subway now under construction on Sixth Avenue is part of the Independent, city-owned, rapid transit railroad, and connects the present Eighth Avenue line at Eighth Street with the Queens and Washington Heights lines at 53d Street. This new subway consists of two tracks from Eighth Street to 31st Street and four tracks from 31st Street to 53d Street, two of which connect to the existing Washington Heights line and two to the existing Queens 53d Street line. The work, comprising six sections, has a total length of 11,363 ft, and the cost of construction, exclusive of track and station finish, is estimated at about $36,000,000.

The two tracks of the new two-track subway between Eighth Street and 31st Street are constructed one on each side of the Hudson and Manhattan Railroad structure. A new temporary terminal for the Hudson and Manhattan Railroad is being constructed at 29th Street, and the existing Hudson and Manhattan structure between 30th and 33d Streets is to be removed and the City subway structure and a new Hudson and Manhattan structure built between these limits.

The new Sixth Avenue Subway passes under the Elevated Line for its entire length, under the existing Hudson and Manhattan structure at Christopher Street, under the existing Broadway–Fourth Avenue B.M.T. line at 34th Street, under the I.R.T. 42d Street shuttle, and also passes over the roof of the Pennsylvania Railroad tunnels in 32d and 33d streets, and the Steinway tunnel line in 41st Street. This work involves many complications due to the necessity of maintaining uninterrupted train service in the structures affected.

The many subsurface structures and the underpinning of adjacent buildings in close proximity to the subway add to the multiplicity of problems to be encountered. The major portion of this subway is constructed through the mica schist which underlies most of Manhattan and generally has been found to be rather blocky, seamy, and soft. The work is the most complicated and difficult subway construction ever undertaken in this city.

The inspection will cover the work between 33d and 47th streets, where may be viewed the various processes of underpinning elevated columns and buildings, street decking and support of subsurface structures, the crossing over the Steinway Tunnel line in 41st Street, the crossing under the shuttle tracks in 42d Street, rock tunnels between 43d and 46th streets, and the erection of steel, concreting, and waterproofing for the subway structure.

Those taking this trip will assemble at Society Headquarters, 33 West 39th Street, New York, N.Y., where guides will escort the party in small groups over the work.

MIDTOWN TUNNEL CONSTRUCTION

Members taking this trip will go directly to the Field Office of the New York Tunnel Authority, situated at 42d Street and the East River.

Among the features to be visited will be the air-compressing plant, which is the largest ever assembled for a tunnel construction job. A shield under erection will also be accessible to the visitors as well as some rock tunneling in normal air.

WEST SIDE PARK AND RAILROAD IMPROVEMENTS

At the last Annual Meeting, the Friday excursion made a brief stop to enable members to see the construction work in progress for improving the Hudson River shore line along an 11-mile front from 72d Street to the northern limits of the city.

This project, the largest construction operation in the East, involves the widening of Riverside Park by filling operations, the placing of a five-track railroad underground, the construction of a six-lane express highway, as well as other park structures, at a cost exceeding $150,000,000.

The express highway has recently been opened to traffic, which enables motorists entering the city from the north to drive to the Holland Tunnel, a distance of some 16 miles, without traversing a grade crossing.

Members wishing to see this work, which involves many complicated types of construction both in steel and reinforced concrete, will assemble at Society Headquarters at 10:00 a.m., whence guides will escort them over the work.

Saturday Trips (*Continued*)

NEW YORK WORLD'S FAIR SITE

Buildings are arising on every hand over the 1,216-acre site of the New York World's Fair of 1939. Some $10,000,000 worth of improvements are "disappearing" in their proper places below ground.

The Fair Corporation's offices, laboratories, and showrooms have occupied the $740,000 Administration Building since August, 1937. Many other buildings, including the Communications Building, the Hall of Shelter, the Business Administration Building, the Hall of Mines and Metallurgy, the Consumer Interests Building, and the Medicine and Health Building are completed or in the final construction stages.

The gates of a tidal control dam are in operation, maintaining the Fair's lagoons with fresh water. The foundations have been completed for, and it is expected that the steel work will be started on, the 700-ft Trylon, or triangular needle, and the Perisphere, the 200-ft globe that will house the "thousand wonders" of the Fair's Theme Center.

The Fair site can be conveniently reached by means of Long Island railroad trains.

Going

Lv. New York (Pennsylvania Station)	9:07 a.m., 10:05 a.m.
Ar. World's Fair	9:23 a.m., 10:22 a.m.

Returning

Lv. World's Fair	11:58 a.m., 12:29 p.m., 12:58 p.m.
Ar. New York (Pennsylvania Station) .	12:14 p.m., 12:45 p.m., 1:14 p.m.

Guides will be provided to show the visitors around the grounds.

Pouring Concrete for Foundation of 200-Ft Diameter Perisphere at the Theme Center of the New York World's Fair of 1939

General Announcements

Sanitary Engineers' Meetings, Dinner, and Inspection Trip

THURSDAY—January 20, 1938—All Day

The Sanitary Engineering Division of the Society extends a cordial invitation to members of the New York State Sewage Works Association to attend the sessions of the Sanitary Engineering Division on Thursday.

Following the sessions, members of the two groups will hold a joint dinner at the Hotel McAlpin, Broadway and 34th Street, New York, N.Y. Dr. Henry E. Riggs, M. Am. Soc. C.E., Honorary Professor, Civil Engineering, University of Michigan, Ann Arbor, Mich., will be the speaker of the evening.

Time, 6:00 p.m. Price of tickets, $2.50 each.

FRIDAY—January 21, 1938—All Day

The annual meeting of the New York State Sewage Works Association will be held at the Hotel McAlpin. All members of the Sanitary Engineering Division are invited to attend.

SATURDAY—January 22, 1938—Morning

Inspection of Wards Island Sewage Treatment Plant

Through the courtesy of the New York Department of Sanitation, members of the New York State Sewage Works Association and the Sanitary Engineering Division will have the opportunity of inspecting the sewage treatment plant on Wards Island recently put in operation.

The party will leave the 34th Street entrance of the Hotel McAlpin by automobile promptly at 9:00 a.m. and return about 1:00 p.m.

Reservations for the trip are to be made through William Raisch, 227 Fulton Street, New York, N.Y.

Railroad Rates

Special convention fares on the certificate basis were discontinued when the general reduction in railroad rates became effective. Since rates are not the same throughout the country, consult your ticket agent regarding special rates and routings.

Facilities of Engineers' Club

For the convenience of out-of-town members, arrangements have been made for members to use the dining facilities of the Engineers' Club on a cash basis. Guest cards for this purpose may be obtained at the Registration Desk. The club will also be able to accommodate a limited number of members, the price of rooms ranging from $2.50 upward. Requests for reservations should be made in advance and addressed to Society Headquarters.

Hotel Accommodations and General Announcements

Hotel Accommodations

In order to be certain of accommodations, members are urged to make definite arrangements for rooms at least a week in advance of the Annual Meeting, paying for the rooms in advance for at least a part of the period during which they expect to be in New York.

Hotel Rates

Hotels	Without Private Bath		With Private Bath	
	Single Room	Double Room	Single Room	Double Room
Waldorf-Astoria	.....	.....	$6.00 up	$9.00 up
Astor	.....	.....	3.50 up	6.00 up
Barclay	.....	.....	5.00 up	8.00 up
Biltmore	.....	.....	6.00 up	8.00 up
Chatham	.....	.....	5.00 up	7.00 up
Claridge	.....	.....	2.00 up	3.00 up
Commodore	.....	.....	3.50 up	5.00 up
Governor Clinton	.....	.....	3.00 up	4.00 up
Lexington	.....	.....	3.50 up	5.00 up
McAlpin	2.50 up	4.00 up	3.50 up	5.00 up
Murray Hill	2.00 up	3.00 up	2.50 up	4.00 up
New Yorker	.....	.....	3.50 up	5.00 up
Pennsylvania	.....	.....	3.50 up	5.00 up
Plaza	.....	.....	6.00 up	8.00 up
Roosevelt	.....	.....	5.00 up	7.00 up
Savoy-Plaza	.....	.....	6.00 up	8.00 up
Taft	.....	3.00 up	2.50 up	3.50 up
Vanderbilt	.....	.....	3.50 up	6.00 up
Woodward	.....	.....	2.50 up	3.50 up

NOTE: The Waldorf-Astoria, at which the reception, dinner, and dance will be held, will care for reservations to the extent of its capacity.

Special Hotel Accommodations

For the convenience of members, arrangements have been made with a number of hotels to furnish accommodations at daily rates which include breakfast, as follows:

Hotels	Single Room With Bath and Breakfast	Double Room With Bath and Breakfast (for 2)	Suite of 2 Rooms With Bath and Breakfast (for 2)
Hotel Albert	$2.50	$3.50	$ 5.00
Hotel Earle	2.50	3.50	5.00
Hotel Van Rensselaer	2.50	3.50	5.00
Hotel Holley	2.50	3.50	5.00
Hotel Wellington	3.00	4.50	6.00
Hotel Vanderbilt	4.25	6.50	11.50

Those interested in the above arrangement should communicate directly with the hotel concerned.

Introductions for Visiting Members

Members who, during their attendance at the Annual Meeting, wish introductions to, or meetings with, engineers in New York City, may call on the Secretary's Office for any service desired.

Information Desk

An information desk is provided in the Reading Room of the Society on the fifteenth floor of the Engineering Societies Building to assist visiting members in obtaining hotel reservations and theater tickets, and in securing any desired information.

Your New York Address

At the Registration Desk a card file of those in attendance will be maintained, with information as to members' hotel addresses in New York. Members are requested to keep Headquarters informed as far as possible of their New York addresses so as to expedite the delivery of telegrams, telephone messages, and mail.

Order All Tickets in Advance

Members who order tickets in advance will not only be saved annoyance and delay by having tickets and badges awaiting them on arrival at Headquarters, but they will assist the committee greatly by giving advance information to guide it in concluding arrangements. Ticket order blanks have been mailed to each member with the condensed program.

No cancellation of tickets can be made after noon of Wednesday, January 19, 1938.

Post-Meeting Trip to Bermuda

Members have already received notice of another trip to Bermuda following the Annual Meeting.

On Saturday, January 22, the party again will sail on the *Monarch of Bermuda*, famous for its equipment and appointments. The Hotel Bermudiana, overlooking the town and harbor of Hamilton, will be the headquarters.

The cruise includes a stop of three days, which may be extended

SCENE IN HAMILTON, BERMUDA

if desired, and the prices include first-class round-trip transportation; room with meals on shipboard; room with bath and all meals at Bermuda; U. S. Government and Bermuda taxes; transfer of passengers and baggage from pier to Hotel Bermudiana; rail transportation from Hamilton to St. George; and transfer from St. George to the *Monarch of Bermuda* for the return.

Make your deposit and hold your cabin if there is a chance that you will go. You may cancel later if you must and your deposit will be returned.

Write to the Secretary, 33 West 39th Street, New York, N.Y., for full information.

Regional Meeting Committee

This program has been prepared under the direction of the Committee on Regional Meetings, EDWARD P. LUPFER, *Vice-President, Am. Soc. C.E., Chairman;* and JAMES K. FINCH, E. R. NEEDLES, CARLTON S. PROCTOR, and WILLIAM J. SHEA, *Directors, Am. Soc. C.E.*

Committee on Local Arrangements for the Annual Meeting

C. W. BRYAN, JR., *Chairman*
E. W. STEARNS, *Vice-Chairman*

DAVID BONNER	EDWARD P. PALMER
E. WARREN BOWDEN	EMIL PRAEGER
WALDO G. BOWMAN	E. A. PRENTIS
S. J. OTT	GLENN S. REEVES

ROBERT W. SAWYER, 3D

Junior Members

ARTHUR A. COLLARD	A. L. OTTO
GEORGE L. CURTIS	T. PATRICK QUILTY
CHESTER L. DALZELL	W. F. SCANTLEBURY
VALENTINE E. DYER	JAMES E. URE

Ladies Committee

MRS. C. W. BRYAN, JR., *Chairman*

MRS. DAVID BONNER	MRS. EMIL PRAEGER
MRS. E. WARREN BOWDEN	MRS. E. A. PRENTIS
MRS. WALDO G. BOWMAN	MRS. CARLTON S. PROCTOR
MRS. LINCOLN BUSH	MRS. GLENN S. REEVES
MRS. JAMES K. FINCH	MRS. ROBERT RIDGWAY
MRS. OTIS E. HOVEY	MRS. ROBERT W. SAWYER, 3D
MRS. HAROLD W. HUDSON	MRS. GEORGE T. SEABURY
MRS. E. R. NEEDLES	MRS. WILLIAM J. SHEA
MRS. S. J. OTT	MRS. E. W. STEARNS
MRS. GEORGE H. PEGRAM	MRS. ARTHUR S. TUTTLE

Please call on the Committee on Local Arrangements or on the Secretary's Office for any service desired.

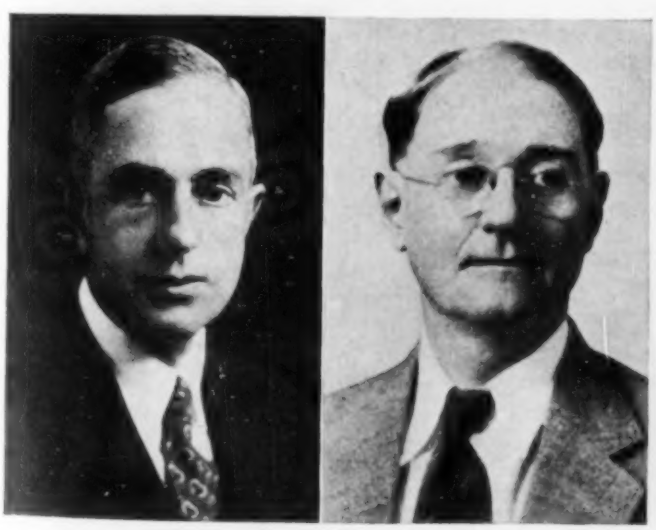
Prizes Awarded for 1937

J. C. STEVENS
Norman Medal for Paper, "The Silt Problem"

INGE LYSE BRUCE G. JOHNSTON
J. James R. Croes Medal for Paper, "Structural Beams in Torsion"

BORIS A. BAKHMETEFF ARTHUR E. MATZKE
James Laurie Prize for Paper, "The Hydraulic Jump in Terms of Dynamic Similarity"

EUGENE A. HARDIN
Thomas Fitch Rowland Prize for Paper, "The Springwells Filtration Plant, Detroit, Michigan"



W. W. HORNER F. L. FLYNT
Rudolph Hering Medal for Paper, "Relation Between Rainfall and Runoff from Small Urban Areas"

E. C. HARWOOD
Arthur M. Wellington Prize for Paper, "Proposed Improvement of the Cape Cod Canal"

VICTOR L. STREETER
Collingwood Prize for Juniors for Paper, "Frictional Resistance in Artificially Roughened Pipes"

SOCIETY AFFAIRS

Official and Semi-Official

Prizes and Medals to Be Presented at Annual Meeting

FOLLOWING ITS USUAL custom, the Society will present prizes and medals at its Annual Meeting, to be held in New York City, January 19–22, 1938. The oldest of these Society awards is the Norman Medal, which was endowed in 1872 by the late George H. Norman, M. Am. Soc. C.E., for an original paper that is considered an especially notable contribution to the engineering profession. Next in distinction is the J. James R. Croes Medal, established by the Society in 1912 and named for the first recipient of the Norman Medal. This award is made for a paper considered second in merit to that receiving the Norman Medal.

In 1884 the late Thomas Fitch Rowland, Hon. M. Am. Soc. C.E., endowed the prize bearing his name, to be awarded for a paper that best describes in detail some accomplished works of construction. For the paper considered second in merit to that awarded the Thomas Fitch Rowland Prize, the Society in 1912 established the James Laurie Prize, which was named in honor of its first President. In 1924 the Sanitary Engineering Division of the Society instituted and endowed the Rudolph Hering Medal, which goes to the author of the paper adjudged to contain the most valuable contribution to the advancement of the sanitary branch of the profession.

The Arthur M. Wellington Prize for the best paper on some phase of transportation was established and endowed by the *Engineering News-Record* in 1921. Although it is not required that the recipient of this prize be a member of the Society, its award rests with the Society. In 1894 the Collingwood Prize for Juniors was established by the late Francis Collingwood, M. Am. Soc. C.E., on his retirement as Secretary of the Society. Papers eligible for this prize must describe an engineering work or record an important investigation with which the writer has been connected. Excellence of style is also a factor in the selection of the paper receiving this prize.

Biographical sketches of those receiving prizes or medals follow.

BORIS A. BAKHMETEFF, M. Am. Soc. C.E., was born in Tiflis, Caucasus, Russia, in 1880. He graduated from the Tiflis Classical Gymnasium in 1898 and from the Institute of Engineers of Ways of Communication, St. Petersburg, in 1903. In 1903 and 1904 he did research work at the Zurich (Switzerland) Polytechnic Institute. From 1905 to 1916 Dr. Bakhmeteff was at the Polytechnical Institute Emperor Peter the Great, where he was assistant professor and, later, professor. In 1911 he received the degree of "Adjunct Applied Mechanics," corresponding to our degree of doctor of engineering. During much of this period (1907 to 1915) he also maintained a consulting practice in St. Petersburg, specializing in hydraulic problems. In addition to the design and construction of a number of smaller plants, he was also connected with such major projects as the Volchow and Immatra plants and the Dneiper project, on which he was chief engineer. During the war Dr. Bakhmeteff served with the Red Cross and, later, with the Central War Industrial Committee. In 1915 and 1916 he was chief plenipotentiary of this committee to the United States and a member of the Anglo-Russian Purchasing Commission, and from 1917 to 1922 he served as ambassador to the U. S. Government in Washington. Since 1923 he has maintained a consulting practice in New York City. He has lectured on advanced hydraulics at numerous American universities, and since 1931 he has served as professor of civil engineering at Columbia University. He is the author of numerous articles on hydraulic subjects, which have appeared in periodicals in this country and Russia, and of several books and monographs. Dr. Bakhmeteff is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, and the Canadian Society of Civil Engineers.

FRANK LEROY FLYNT, Assoc. M. Am. Soc. C.E., was born at Plattsburg, Mo., on September 4, 1885. He attended the Missouri School of Mines at Rolla, Mo., receiving the degree of B.S. in civil engineering in 1910. He received the degree of C.E. from the same school in 1932. Mr. Flynt began engineering work with the Atlanta, Birmingham and Atlantic Railway as rodman on railway construction in 1906, and he served as city engineer of Maryville, Mo., from 1910 to 1915. In 1916–1917 he was with the Valuation Department of the Louisiana Railway and Navigation Company in Shreveport, La., and later was assistant division engineer, maintenance of way, with the St. Louis, Southwestern Railway. From 1917 to 1920 Mr. Flynt was in the Valuation Department of the St. Louis-San Francisco Railway, and from 1920 to 1924 he was assistant division engineer, maintenance of way, for the same railroad. From May 1924 to May 1934 Mr. Flynt was in the Sewer Design Department of the City of St. Louis, Mo., engaged mainly in the design of relief sewers and in research in rainfall and runoff. In 1935 he spent several months with the National Park Service as associate engineer in connection with a study of the pollution of Rock Creek in the city of Washington, D.C. Later in the year, he worked for a few months on sewer design for the Webster Groves Sanitary Sewer District, Webster Groves, Mo., and from January to July 1936 he was engaged in making investigations and reports for the Bureau of Agricultural Engineering covering proposed drainage projects for Camp D-2, Mo. Since August 1936, Mr. Flynt has been with the U. S. Engineering Corps, and at the present time is principal engineering aide in the District Engineer's Office at Rock Island, Ill., engaged in making flood control studies on certain tributaries.

EUGENE A. HARDIN, M. Am. Soc. C.E., was born in Ottawa, Kans., on November 21, 1895, graduated from Baker University in 1918 with a bachelor of arts degree, and served in the U. S. Army with Base Hospital Corps No. 28 from December 1917 to August 1919. While overseas he was one of a detachment of U. S. Army students sent to the Université d'Aixe-Marseille to study French, engineering, and science during the spring term of 1919. On his return to the United States, he entered the Massachusetts Institute of Technology, graduating in 1921 with the degree of bachelor of science in civil engineering. He was in the employ of Black and Veatch, consulting engineers of Kansas City, Mo., from July 1921 to February 1925 engaged in general municipal engineering work both in office and field. From March 1925 to June 1932 he was employed in the Department of Water Supply of the City of Detroit, Mich., as designing engineer of filtration plants. On the completion of the Springwells Filtration Plant Mr. Hardin returned to the employ of Black and Veatch, specializing in water purification and sewage treatment plants from 1932 to 1936. In the spring of 1936 he returned to Detroit where he is now employed as one of the designing engineers in the Department of Public Works engaged on the design and construction of the Detroit Sewage Treatment Plant. Besides his activities in consulting and municipal engineering work, he has published a number of technical articles, including a census of data on the large rapid sand-filter plants in the United States and Canada. While in the Detroit Department

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of Water Supply he was instrumental in developing several unique improvements in plant design and equipment. He has served the Society on local committees and is now a member of the Sanitary Section's Committee on Water Purification Plant Design and Research. He is also a member of the American Water Works Association, the Michigan Engineering Society, and the Engineering Society of Detroit.

EDWARD CROSBY HARWOOD, an engineer-economist, was born on October 28, 1900. He graduated from the U. S. Military Academy at West Point in 1920, and then attended the Fort Humphreys Engineer School. He received the C.E. degree from Rensselaer Polytechnic Institute in 1922; the M.C.E. degree in 1930; and the M.B.A. degree in 1931. He is a member of Sigma Xi. He directed CCC construction work in New England in 1933, and was executive officer on the Cape Cod Canal Improvement, 1935–1936. He retired from the Corps of Engineers, U. S. Army, with the rank of captain in 1937 under the Voluntary Retirement Act. At present, he is the Director of American Institute for Economic Research, Cambridge, Mass. Captain Harwood is the author of books, booklets, and articles on economic and financial subjects, and has also contributed articles to engineering journals. He is a member of the Economists National Committee on Monetary Policy.

W. W. HORNER, M. Am. Soc. C.E., was educated at Washington University (St. Louis), receiving the degree of bachelor of science in civil engineering in 1905 and the degree of civil engineer in 1909. From 1905 to 1918 he held various positions in the engineering organization of the City of St. Louis, including the responsibility for design of sewers and of paving. From 1918 to 1933 he was Chief Engineer of Sewers and Paving for the City of St. Louis in charge of all design and construction. In the latter year, Mr. Horner established a consulting engineering practice in St. Louis, continuing with the City of St. Louis as consulting engineer, and specializing in municipal, sanitary, and hydraulic problems. His clients have included numerous cities and sanitary and drainage districts in the Middle West. He served as consultant to the Public Works Administration, and is now serving as water consultant to the National Resources Committee. From 1934 to 1937 he was special lecturer at Washington University, and he was recently appointed professor of municipal and sanitary engineering. Mr. Horner has contributed articles to the publications of the Society and to numerous other periodicals. He is a member of Sigma Xi and Tau Beta Pi; member and former president of the Engineers Club of St. Louis and of the American Public Works Association; and member of the American Society for Testing Materials, the American Geophysical Union, and the American Institute of Consulting Engineers. He is a Member and former Director of the American Society of Civil Engineers, and has served on the Executive Committee of the Sanitary Engineering Division and as chairman of the special committee that prepared a manual on "Definition of Terms Used in Sewerage and Sewage Disposal Practice." He is also a member of the Society's Committee on Street Thoroughfares Manual and of the Committee on Planning of Underground Utilities.

BRUCE JOHNSTON, Assoc. M. Am. Soc. C.E., was born in Detroit, Mich., on October 13, 1905. Before graduating from the University of Illinois in 1930, he spent several summers on construction work. He also spent two years (February 1927 to February 1929), with the U. S. Indian Irrigation Service on the construction of Coolidge Dam, where he had charge of the control and design of concrete mixes under the direction of H. C. Neuffer, M. Am. Soc. C.E. During his last summer at the University of Illinois, he assisted in laboratory research, and after graduation worked for one year as structural detailer and designer with the Roberts and Schaefer Engineering Company, Chicago, Ill. In September 1932, he accepted an appointment as research fellow at Lehigh University to conduct, in cooperation with the Bethlehem Steel Company, an investigation of the torsional strength of structural steel sections. In June 1934, he received his master of science degree from Lehigh University and became instructor in civil engineering at Columbia University, where he has continued research work in the field of steel structures. He recently completed a series of tests on pin-connected plates and, in cooperation with the American Institute of Steel Construction, is now starting an investigation of the strength of web splices in plate girders. During the past summer Mr. Johnston spent six weeks in French Cameroon, West Africa, superintending the erection of the roof trusses of an American church now being completed there. He is a member of the American Concrete Institute, the International Association for Bridge and Structural Engineering, and the Society for the Promotion of Engineering Education.

INGE LYSE, M. Am. Soc. C.E., was born in Lysebotn, Norway, on October 22, 1898, and graduated from Norway's Institute of Technology in 1923. In 1937 he was awarded the degree of doctor of technology from his alma mater. Immediately following his graduation, he came to the United States and was employed by the Southern California Edison Company on its Big Creek Hydroelectric Project until 1926, when the construction of the Stevenson Creek Experimental Arch Dam was begun by the Engineering Foundation. He became principal assistant to the late W. A. Slater, M. Am. Soc. C.E., on this experiment. After the completion of the report of this experiment, which was published in the May 1928 PROCEEDINGS, he joined the research staff of the Portland Cement Association as an assistant to F. R. McMillan, M. Am. Soc. C.E., director of research. In 1929 he became the Portland Cement Association's representative in direct charge of the experiments at the Fritz Engineering Laboratory, Lehigh University, under Professor Slater's direction. At the completion of this investigation in 1931 he accepted a position as research assistant professor of engineering materials at Lehigh University. He became associate professor in 1933 and full professor in 1937. Since the death of Professor Slater in October 1931, Professor Lyse has been in charge of the Fritz Engineering Laboratory and has conducted graduate instruction in the department of civil engineering. Professor Lyse is the author and co-author of some fifty technical papers and articles in domestic and foreign engineering publications. On May 19, 1937, he received the Franklin Institute's Gold Medal. He is a member of Sigma Xi and of a number of engineering and educational societies, and has many committee assignments. He is a member of the Board of Direction of the American Concrete Institute, and he represents the American Society of Civil Engineers on the Division of Engineering and Industrial Research of the National Research Council.

ARTHUR E. MATZKE, Jun. Am. Soc. C.E., received the bachelor of arts degree from Columbia University in 1928 and the civil engineering degree from the same institution in 1930. Prior to graduation, he was employed as engineering assistant on the construction of the Independent Subway System in New York City. Following graduation he worked for the Materials Testing Laboratory of the Civil Engineering Department of Columbia University on the testing of fire-resistant materials. He than became job engineer for the Robert W. Briggs Construction Corporation on the construction of reinforced concrete arch bridges in Westchester County, New York. In December 1933 he returned to Columbia University as research assistant in the Fluid Mechanics Laboratory.

J. C. STEVENS, M. Am. Soc. C.E., received his early schooling in Knoxville, Iowa. In 1898 he enlisted in the 51st Iowa Volunteer Infantry and saw service in the Philippine Islands. Upon his return to the United States he entered the University of Nebraska. In his junior year he was appointed assistant state engineer of Nebraska. He had taken the civil service examination in the then new Reclamation Service and was appointed assistant engineer in 1902 and was assigned to hydrographic work in the state of Nebraska. Later his employment was changed to a per diem basis to permit him to finish his university work and, at the same time, to carry on a certain amount of stream-gaging work within the state. He graduated from the University of Nebraska in 1905 with a B.S.C.E. degree. In 1928 a professional degree of civil engineer was granted him by the University of Nebraska on his thesis, "The Hydraulic Jump." He remained in government service until 1910, the last position being district engineer, U. S. Geological Survey, in charge of work for the Water Re-

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sources Branch in the Pacific Northwest. In 1910 he opened an office for private practice in Portland, Ore. The years 1912 to 1914 were spent in Spain on design and construction of hydro-electric plants for the Pearson Engineering Corporation. Upon his return to this country he constructed the Oroville-Tonasket Irrigation Project in Washington. Shortly thereafter he formed a partnership with R. E. Koon, M. Am. Soc. C.E., and has since been engaged in the practice of hydraulic engineering under the firm name of Stevens and Koon, consulting engineers, Portland, Ore. He is the author of numerous articles on hydraulic engineering. In 1932–1934 he served as Director of the American Society of Civil Engineers. He also served the Society for ten years as secretary of the Special Committee on Irrigation Hydraulics and is at present chairman of the Special Committee on Hydraulic Research.

VICTOR L. STREETER, Jun. Am. Soc. C.E., received his engineering education at the University of Michigan. He received the bachelor's degree in 1931, the master's degree in 1932, and the doctor of science degree in 1934. From 1934 to 1935 he was employed by the U. S. Bureau of Reclamation in Denver, Colo., where he was a junior engineer in the hydraulic studies department. He was appointed Freeman Scholar by the American Society of Mechanical Engineers, and spent a year at the University of Göttingen and Karlsruhe Technische Hochschule, Germany, and six months traveling through Europe, the Orient, and the western part of the United States visiting hydraulic laboratories. Since December 1936 he has been an assistant engineer in the U. S. Bureau of Reclamation in Denver, in the hydraulic laboratory. His work has been the design, construction, and operation of hydraulic models, as well as technical studies concerning prototype design. He is a Junior Member of the American Society of Mechanical Engineers.

New Elections to Honorary Membership

GEORGE S. DAVISON

IN THE western part of Pennsylvania, where the great Monongahela and Alleghany rivers unite to form the still greater Ohio, lies the important industrial area of which Pittsburgh is the metropolis. Nature has been prodigal in bestowing lavish gifts on this manufacturing center. During the last half century it has prospered mightily and many leaders of business, finance, and art have developed there. Among these famous names, now almost bywords, few have been associated with a greater variety of important civic and industrial enterprises than George Stewart Davison.

GEORGE S. DAVISON

Yet in a strictly technical sense, Mr. Davison is not a native of Pittsburgh at all. He missed that distinction by a distance of perhaps two or three miles. When he was born in Lawrenceville, September 1856, that borough was still unannexed. With the enlargement of the city, it is now in the very heart of industrial Pittsburgh, but before the Civil War it was still no more than a close suburb. As might be expected, the boy attended a typical "little red schoolhouse," and was brought up on McGuffey's readers and similar classic textbooks. There is a pleasant tradition among old residents that when the propitious time came for annexing Lawrenceville to Pittsburgh, little red schoolhouse and all, one of the outstanding reasons was the desire to claim a person named Davison. Certain it is that the city has possessed him, his energies, and his civic accomplishments in all the succeeding years.

In September 1874, Mr. Davison entered Rensselaer Polytechnic Institute, from which he graduated in 1878 with Sigma Xi honors. In his senior year by popular vote of the undergraduates, he was elected grand marshal of the student body. In his anxiety to get started in business, he took the first job available, as clerk for the Pennsylvania Railroad in Pittsburgh. But he could not disguise the fact that he was a miserable penman, and so his boss, the late Thomas Rodd, member of the Society, gave him work at tracing. This incident shifted him into his own chosen profession, but it did more—it began a friendship which lasted until Mr. Rodd's death fifty years later.

Then came a short period of work on surveys and current observations on the Missouri and Mississippi rivers. From this he contracted malaria, which eventually seriously affected his health. So in April 1880, he accepted an offer from the engineering department of the Atchison, Topeka and Santa Fe Railroad in Topeka. As it happened, Charles F. Loweth, afterward President of the Society, entered the same office the same day. Thus was formed another life-long friendship.

It was during a short vacation in Pittsburgh that same summer that Mr. Davison's whole life was changed. As he left the train at Pittsburgh he ran into his old friend, Thomas Rodd. This meeting, combined with his mother's serious illness, brought him back to Pittsburgh; he never left again.

Fortune favored him. Shortly his superior, superintendent of the Pittsburgh Division, Pennsylvania Lines West, resigned to accept a better position constructing and operating a new railroad that was to tap the rich bituminous coal fields near Pittsburgh. He made Mr. Davison his chief engineer. Soon another resignation promoted him again, and he became general superintendent as well as chief engineer. This work gave him excellent railroad and industrial experience for ten years.

In January 1890, he entered private practice, in partnership with a close college friend, William G. Wilkins, member of the Society—another long friendship which lasted until Mr. Wilkins' death thirty years later. This ten years of association was successful both professionally and financially. The pair made important contributions in the extension of mining operations and coke plants, the construction of mills, furnaces, and railroads.

It was during this period that he began to serve the Mellon interests, a connection which continued directly for thirty-three years, while certain accessory features have lasted up to the present time. Beginning in 1900 he expanded his work from those phases which were primarily engineering to those of general engineering character. He was general manager and secretary of urban and interurban street railways as well as president of the Pennsylvania Water Company, a position he still holds.

In August 1904, he was called into the service of what is now known as the Gulf Oil Corporation, a connection that only ended twenty-five years later. His first title there was "Assistant to the Vice-President." For many years prior to his retirement from this industry he was vice-president of the Gulf Oil Corporation, a holding company, and president of some twenty underlying companies, including the Gulf Refining Company. At the time of his resignation, the assets of the Gulf Oil Corporation were just short of seven hundred million dollars—a great contrast to the twenty million dollars they were at the beginning of his connection.

Feeling that his days might extend beyond the limit when his services would command compensation, and realizing that continued good health and happiness could be had only through "a good day's work well done," he prepared for the time when he would be his own master. He has often boasted that he never speculated in securities, as the excitement of following the market might hold his interest to the detriment of his other affairs. Instead, alone, and at times with others, he founded new industries for Pittsburgh. He admits now that some of these were rank failures, but on the whole they increased the employment of labor and kept him busy to the present day. In 1914, with his son, he formed the Allen S. Davison Company, which has been a holding company for their share in some later enterprises. Besides being president of the original company, he is president of the Green Bag Cement Company of West Virginia, and chairman of the board of the Pittsburgh Coke and Iron Company (formerly Davison Coke and Iron Co.).

No one has contributed more than Mr. Davison to civic betterment in Pittsburgh. As far back as 1893, he was on a joint committee to study the ravages of typhoid fever. After extensive investigations and reports, the city built a sand filtration plant which shortly caused this dread disease practically to disappear.

In the development of rapid transit, he has taken a conspicuous part; he was chairman of the City Transit Commission from 1925 to 1935.

Flood control has long been a serious local engineering problem, and still is. With the recent recognition by the federal government of its obligations, Mr. Davison is entitled to feel a peculiar degree of satisfaction inasmuch as he has advocated such public control measures for thirty years. Following the disastrous flood of 1907, he became president of the Pittsburgh Flood Commission, which included other Society members.

In city planning he was also a leader. Topographic handicaps around Pittsburgh are notoriously difficult. During the three years in which Mr. Davison was a member of the City Planning Commission, complete plans were devised to relieve traffic congestion. Later he was a member of a second committee, a voluntary civic organization, with the same general purposes.

In the Davison family, even to the third generation, it has become a tradition to attend Rensselaer Polytechnic Institute. He is a member of the Delta Phi fraternity, as are his son and his four grandsons. That famous college has no more loyal alumnus than Mr. Davison, who has been a trustee continuously since 1909. In that year he was invited to raise the necessary funds for erecting a new administration building. With characteristic zest he accepted. Funds were secured wholly from interested residents of his home city, and so it came about that the trustees of the institute returned the honor by designating the hall as the Pittsburgh Building. He has still another strong tie to Troy, N.Y., for in 1881 he was married to Clara Elizabeth Lape, of that city.

In recognition of all his activities, civic, professional, and educational, he was made a doctor of engineering by Rensselaer in 1926, at its centennial celebration. The University of Pittsburgh made him an honorary doctor of science in the same year. As both these distinctions came while he held the office of President of the Society, they may be considered as compliments to this organization also. The citation for the latter degree expressed the general attitude towards him when it stated that it was given "in recognition of high attainment and the motive of service." The tribute was all the more notable because he had no social, educational, or business connection whatever with the University of Pittsburgh.

Technical and service organizations have also claimed his interest and help. In 1880 he joined with other local engineers in forming the Engineers' Society of Western Pennsylvania. Today, after 58 years, he is the only surviving member of the original group. He served as president in 1898.

Two important edifices in Pittsburgh reflect his engineering and business judgment. For sixteen years he was president of the board of trustees of the Edgewood Presbyterian Church, during which time a beautiful new church building was erected, all within the means of the congregation. During the last two years of his connection with the Gulf organization he secured the title for a site and devoted himself to designing a building to house its affiliated companies. The structure is beautiful in form and monumental in size. It rises almost 600 ft, the tallest office building in Pittsburgh.

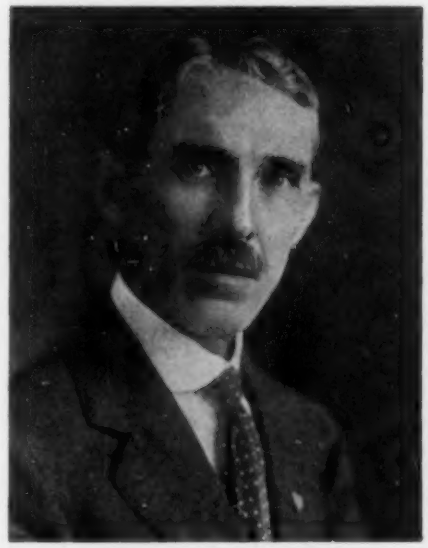
In the Society, Mr. Davison's connection goes back almost fifty years. Following service in 1903–1905 as a Director, his business activities and local civic interests occupied his time, but his genuine pride in the organization was still strong. Twenty years later, local engineering friends sought him out and prevailed upon him to be of further service. Thus it was that he was elected Vice-President in 1923–1924 and became President in 1926. He represented the Society as a delegate at the dedication of the memorial carillon at Louvain Cathedral in 1928, and was its official delegate at the World's Engineering Congress in Japan in 1929. It was his privilege on May 13, 1924, to present to the Hall of Fame in New York City a bust of Capt. James B. Eads, on behalf of the engineers of America.

In the business affairs of the organization he has always exhibited a keen insight into practical matters. He has also entered wholeheartedly into its social activities. To occasions of dignity he rises naturally, and when hilarity is in the air he enjoys that just as thoroughly, frequently with a mien of imperturbable gravity that only adds to the pleasure of his companions.

By heritage and choice he claims allegiance to the Presbyterian Church and the Republican Party. To these, by unanimous judgment of his fellow engineers, is now added that most important professional acknowledgment, Honorary Membership in the Society.

HUNTER McDONALD

To EVERY red-blooded boy the glamour of war has a stirring appeal. The march of troops, the rattle of musketry, the cheers of the victors—all possess an indescribable fascination. To such a boy no place could have been more attractive than Winchester, Va., where Hunter McDonald was born just before the Civil War. That beautiful town lay right in the path of the opposing armies. Again and again it changed hands as the tides of war swept back and forth, up and down the Shenandoah Valley. All the able-bodied men had gone to war and only the women and children and a few servants were left. The McDonald family were hard put to it to preserve their home against the insistent demands of the military forces. For months, even years, they held on tenaciously, succeeding by subtlety, by flattery, even by braggadocio, in keeping their own roof over their heads. Finally, all expedients failed; the mansion was taken over for a Yankee hospital; and the family was forced to flee south within the Confederate lines.



HUNTER McDONALD

But Hunter McDonald, then a baby in arms, knew little of the horrors through which he was passing. In fact, he probably never knew his own father, Col. Angus W. McDonald. Hunter's younger sister died during the war, so that he was the youngest surviving from a family which totaled nine by the first marriage and nine by the second wife, Hunter's mother. Colonel McDonald was 61 when the child was born. A year later he went into the Confederate service and died before the war was over.

After the family was refugeed out of Winchester, they settled in Lexington, Va. In later life Mr. McDonald was fond of telling how Gen. Robert E. Lee, often overtaking him as a small boy on the road, would lift him up for a horseback ride on his famous Traveler. A decade passed in Lexington; then it was decided that the family would move to Louisville, Ky. One instance, Mr. McDonald related, nearly caused this hegira to come to a full stop. Before leaving, his brother Allan made up a party to take one more look at the Natural Bridge. Allan had the tickets and money in a large pocketbook, and according to the custom at that time, carried it in the inside pocket of his coat. While he was lying face down, looking over the bridge into the gorge, the precious book fell out and lodged on a ledge, said to have been about 120 ft below. Efforts to dislodge it by throwing stones proved fruitless. A consultation was held and, he recorded, "over the vigorous protests of the ladies, it was decided to lower me on a rope. Seated on a stick tied at the end of the rope, I was gently swung out into space, two men holding the rope and my brother paying it out gradually from two wraps around a nearby tree. I revolved slowly and helplessly in the descent until it was discovered that about 25 ft more of rope was needed. After an hour the rope was lengthened and I resumed my journey. I found a safe landing on the ledge, crawled on hands and knees for about 60 ft, recovered the book, and was hoisted to safety, where I was hugged and kissed by the ladies."

With the family fortune thus retrieved, the journey was safely accomplished. Part of the trip was by railroad. As this was Hunter's first experience of such travel, he became panicky and had to be blindfolded before he could be got aboard the train.

This experience was hardly auspicious for one who was to devote his entire professional life to railroad engineering. After schooling in Louisville, he entered Washington and Lee University, with the intention of becoming an engineer. But shortly he returned, sick with chills and fever. Through one of his brothers he got temporary work surveying for the Louisville, Nashville and Great Southern Railroad. Here within a month his health was restored and he greatly enjoyed the measurement of 950 miles from Louisville to Montgomery, Ala. The rough life, the attempt to maintain accuracy with a crude chain that was continually changing its length, the ever-present danger of accidents (eventually they did lose their handcar), all proved an exhilarating experience.

Although he quickly worked himself out of this job, the young engineer had made a reputation which brought him a permanent appointment as assistant to the chief engineer of the Nashville, Chattanooga and St. Louis Railroad, beginning in December 1879. In thirteen years he became chief engineer of the system, which position he held through the remainder of his active engineering experience. Other responsibilities were added during the period; he became chief engineer of the Tennessee Central and the Birmingham and Northwestern road while they were under the control of the government; and from 1906 onward he had charge of constructing property for the Wholesale Merchants Warehouse Company in Nashville and continued as general manager of the company thereafter. He retired in 1932 after a career that was notable even among railroad engineers, who frequently enjoy long and distinguished services with a single company.

Throughout his professional life Mr. McDonald's interest in the advancement of his calling was wide. He was an active worker in many organizations. After assisting in founding the Engineering Association of the South, he was its president in 1895–1896. Similarly, in 1904 he was president of the Railway Engineering Association and later became an honorary member. He served the Society as Director (1903–1905), as Vice-President (1910–1911), and as President in 1914.

In 1900 he organized and established the Highland Summer Club, thirty miles west of Nashville. There for many years his family, with those of other members, spent the hot summer months in the virgin forest 900 ft above sea level. Later, in 1912, he bought a rocky island in Wahuapitac Bay, northern Ontario, and there built a camp named "Craggan and Phithich," taken from his family crest, meaning "The Raven on the Rock." He has also enjoyed membership in "Old Oaks," a literary club in Nashville. In golf, he claimed he always "aimed at mediocrity in record and the maximum of enjoyment."

He was never physically robust. As a baby, his health was delicate and the cause of much worry. Considering the tribulations through which the family passed, it is rather remarkable that he was able so well to overcome these limitations. Nevertheless he was a great sportsman and fisherman. On Thanksgiving Day, 1884, as a member of a football team from the Nashville Athletic Club, contending against a picked eleven from eastern colleges, he ran 70 yards to a touchdown. This was the first game of football played south of the Ohio River.

Although he contributed generously to every civic and educational enterprise in his community, his favorite philanthropy was the education of boys and young men. He gave many scholarships to secondary schools in order to help boys find their place in life, and in addition assisted numbers of talented and ambitious young men to complete their technical education. Some of these men entered his own organization, which they have served with a rare devotion and loyalty.

All his life, Mr. McDonald was an inveterate reader and possessed a broad knowledge of literature and a cultural background. He had an inexhaustible fund of anecdotes and humorous stories to fit any occasion. With his remarkable memory he preserved a store of songs and ballads, many of which had never been printed, but were handed down through generations of slaves in his family.

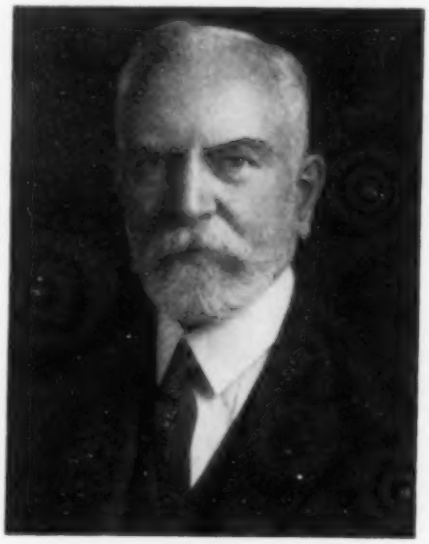
Following his retirement, he was able to devote himself to a literary task of magnitude. During the Civil War his mother had written a fascinating record. Such diaries of Confederate sympathizers had to be kept in secret. Names were generally omitted, for fear of discovery. When no more blank paper was available, resort was had to writing between the leaves of printed books. He assembled the various parts and generously annotated and supplemented the diary by a large amount of genealogical data, obtained by dint of much effort and correspondence. The resulting volume of 540 pages comprises a fascinating record of his notable family. It is entitled *A Diary with Reminiscences of the War and Refugee Life in the Shenandoah Valley.* Mr. McDonald deposited a complimentary copy in the Society library. This monumental work, replete with adventure, pathos, and humor, will bear intensive study by those who are interested in following details of the heroic days of war and reconstruction life in Virginia.

It is indeed a pity that Hunter McDonald did not live to learn of the action creating him an Honorary Member of the Society. The necessary formalities had been completed and only the canvass of the ballots was necessary. His many friends will thus join in silent tribute to one who, by word and act, by character and professional attainment, by surmounting difficulties, became an honored leader in civil engineering life in America.

OTIS ELLIS HOVEY

NOW AND again at important gatherings of engineers, someone is bound to inquire, "Who is that tall, distinguished-looking man, with the handsome white beard?" Thereby, the questioner reveals that he is a comparative stranger at Society meetings, for no one has been more faithful or better known than Otis Ellis Hovey. Perhaps the beard has not always been so white, but for a number of decades it has been a distinguishing characteristic.

His professional work and his Society activities have carried him far and wide—it seems unnecessary to dwell at length on his life history. He is a product of the substantial state of Vermont. There, in East Hardwick, in a beautiful valley of the Green Mountains, not a great many miles from the Canadian line, he was born about at the close of the Civil War. In those days, as he was developing his mind and preparing for his life work, one of the few prominent schools for civil engineers was at Dartmouth College, some eighty miles south, in the neighboring Connecticut Valley. Here the country boy went and with characteristic self-discipline and hard work obtained his bachelor's degree in 1885, followed by that of civil engineer from the Thayer School in 1889. Through all the intervening years, Dr. Hovey has kept his great loyalty for, and interest in, Vermont and Dartmouth College.



OTIS ELLIS HOVEY

Intervening between his two college degrees, work in New England contributed valuable experience in railroad engineering and in steel design and drafting. On receiving his professional degree, he went into the Middle West, for one year and a half as instructor at Washington University, St. Louis, and then for six years as assistant to the late George S. Morison, M. Am. Soc. C.E., in Chicago, on bridge and other engineering design. Morison was at that time one of the leading experts in his field; he was also active in Society affairs serving as President in 1895. It was perfectly natural therefore that these two activities should have impressed the young assistant so deeply that one became his vocation and the other a principal avocation throughout his life.

A few years with the Union Bridge Company at Athens, Pa., and he was still better prepared for his great life work. In 1910 the American Bridge Company was organized and he was transferred to its Pencoyd office. For seven years he was engineer of design at Pencoyd, Pa., and at New York, and then became assistant chief engineer of the company, a position he held for 24 years.

This period of Dr. Hovey's work was during the heyday of bridge building. Railroad expansion accounted for a great deal of the earlier work, while later the highway field came into prominence.

These and other important types of structures provided an outlet for his superb analytical talents. Among other of his particular interests was the subject of movable bridges. He became an authority in this field, had charge of many of the most important spans, and in 1926 and 1927 published a two-volume treatise which has become a standard for such work.

For three years, from 1931 to 1934, he was consulting engineer of the Bridge Company and since that time has been in private practice as consulting engineer, specializing in bridge design and in structural and mechanical engineering. For almost forty-five years, Dr. Hovey has been a Corporate Member of the Society. During this time he has been intensely interested in its work and has himself contributed a material share to its advancement. He was a member of the special committee which submitted notable final reports on steel highway and on steel railway bridge superstructures 15 years ago. Since 1921 he has served as Treasurer of the Society, giving to that office a faithful, methodical, and intelligent administration.

Continuously from his college days he has kept his vital enthusiasm and interest in the training of younger men. For twenty years he has been lecturer by invitation at both Yale and Princeton. Clarkson College has honored him and itself by making him an honorary doctor of science. Perhaps one of his most prized honors was the conferring by his own beloved Dartmouth College of the honorary degree of doctor of engineering in 1927. This recognized not only his eminence as an engineer but also the time and effort which he had given unstintingly for many years as a member of the Board of Overseers of the Thayer School. Through his efforts, many a graduate has secured a position in the engineering profession. For twenty-five years he has perhaps been personally acquainted with more college alumni than any other graduate, and they look up to him as a model engineer, to be emulated in character as well as in professional ideals and accomplishments.

Similarly, in all his long years of service with the American Bridge Company, he was the one above all others to whom the younger engineers turned for advice and assistance, in engineering as well as in personal problems. He was never the kind to dismiss such inquiries with impatience; his counsel was always sound. The young man was made to feel that the analysis was not a perfunctory one, but rather that Dr. Hovey had dismissed other pressing matters from his mind and was devoting his entire attention to the difficulty. Many practicing engineers of increasing fame can justly ascribe a good deal of their success to his advice and example. There is a kindliness and cordiality in his greeting to every visitor in his office, even though clouds of smoke from his ever-present pipe indicate that he is deep in the solution of some abstruse mathematical problem which hardly admits of interruption.

His genius for friendship, his remarkable grasp and memory of technical matters are widely known. But his busy life has also provided time for family and cultural matters. As their children are now grown and married, Mr. and Mrs. Hovey have found greater freedom of action and interest. One of their most recent ventures is the acquisition of a fine old residence in the town of Hartford, in his native state of Vermont, a delightful place to which they can retire in summer, not too far from the pleasant scenes of his undergraduate activities.

One of his early hobbies was photography, especially when that art was in the first stages of development and most cameras were home made. His photographs are always taken with the same mathematical precision he uses in the solution of his engineering problems—and with equal pride of performance. He is particularly expert in photographing drawings and illustrations appearing in engineering literature. In music also he is an accomplished artist. Not only does he take great joy in various kinds of music, but he is himself a talented flute player. Some years ago he assisted, with J. E. Greiner playing his Stradivarius violin and with Ralph Modjeski at the piano, in an evening of music which is still vividly remembered not only for its artistry but for the celebrity of the performers.

It might be thought that at his stage of life Dr. Hovey would be more than ready to sit by his fireside and enjoy a well-earned rest. Far from it—honors and work still crowd in upon him. Only last fall his successful life work was recognized in the bestowal of an alumni membership in Phi Beta Kappa, at the 150th anniversary of that society held at Dartmouth College. More recently, he was offered, and accepted, the directorship of the Engineering Foundation, an activity with which he had been associated since 1930 as the Society's representative. This new task, as successor to the late Alfred D. Flinn, gives him wider scope for employing his intimate knowledge of engineers and engineering and an outlet for his intense interest in research and the advancement of engineering. The tribute of Honorary Membership in the Society is at once a recognition of his latest eminence as an engineer and a confident challenge to still further accomplishment in the profession.

JOSEPH R. WORCESTER

Greatness almost defies definition. Its qualities are recognized and passively accepted, but unconsciously we tend to think in terms of personality rather than attributes. There are certain persons who are so universally acclaimed that their eminence is taken for granted, while others attain it just as surely through quiet, unobtrusive lives, unheralded beyond their immediate associates. Such a man is Joseph R. Worcester, who has been prominent in the field of structural engineering for the entire period of his long experience; he has been known for his good works, both personal and professional; and his high standing as a man has always been recognized by a host of friends. It is therefore a most fitting distinction that now comes to him in the form of Honorary Membership in the Society.

Joseph R. Worcester

One possible explanation for this lack of wide acclaim, aside from his own retiring disposition, is that his life has been pursued within a rather narrow radius geographically. His interests have been wide, his connections many, but his residence has been confined to the vicinity of Boston. He was born in Waltham in 1860, and he still lives there. He entered practice at Boston in 1882; his office has been in that city ever since. Even his education, although ample, was local—he graduated from Harvard College with an A.B. degree in 1882. Twenty-five years after graduation his class report said of him, "Worcester is indeed the Pontifex Maximus of the class, although he is far too modest to admit it."

To be one of a family of eleven children is in itself an experience in discipline and cooperation. With this training for hard work, Mr. Worcester has been noted for his diligence as well as his care. A fellow engineer once commented on the exactness of a certain stress diagram which had been so precisely prepared by Mr. Worcester that he had to consult it with a reading glass.

His life work in outline can be quickly told. Upon graduation he affiliated with the Boston Bridge Works, remaining with that company for twelve years, most of the time as chief engineer. Then in 1894 he established his own firm in consulting practice, a connection he pursued actively until 1924, when he retired to the position of consultant only. He early made a name as one of the pioneers in reinforced-concrete design and construction, establishing himself at the top rung at the very beginning of American interest in this form of construction. As a result, the greater part of the earlier reinforced-concrete buildings in Boston, as well as many arch bridges in New England, were designed and constructed from his plans.

His facility and interest in this field also accounted for one of his great professional contributions. From 1904 to 1917 he represented the Society on the first Joint Committee on Concrete and Reinforced Concrete, for a number of years as chairman. But his interest went further than concrete—he served for ten years on the Society's Special Committee on Steel Columns and Struts. As a continuation of both these activities in 1921 he was appointed a member of the Federal Building Code Committee

by Herbert Hoover, then Secretary of Commerce. The resulting building code, covering all branches of the building industry, soon became the basis for similar local codes throughout the United States. Many steel structures throughout New England bore the imprint of his genius. His ability was recognized publicly when he was appointed by the General Court of Massachusetts as a member of the Memorial Bridge Commission in charge of a $6,000,000 bridge across the Connecticut River at Springfield. Around Boston alone he was responsible for important consulting and designing work for the Boston Elevated Railway Company, the Transit Commission, the East Boston tunnel, the Cambridge subway and viaduct, and the Harvard Stadium.

Because of his innate modesty Mr. Worcester has never taken any very prominent leadership in civic affairs. Yet he has held many positions of engineering and public trust, such as vice-president of the Waltham Savings Bank, president of the board of trustees of the local hospital, president of the Harvard Engineering Society and of the Boston Society of Civil Engineers.

He seems to have exhibited an early fondness for the sea; his diary records that he "bought first dory at age of 15." And so for sixty years or more he has spent his summers on one of the most picturesque spots of the New England coast, at Rockport, Mass. In his early youth he and another boy purchased a printing press and sufficient type to publish a school paper. Ever since, he has maintained his interest in printing, both from the artistic standpoint and on the basis of accuracy. A manuscript becomes a proof in his hands and his eye detects instantly any typographical error. This is all the more remarkable considering the immense amount of reading that he does—reading in all fields, extending from the scientific, including his own life study of engineering, to the more recreational which brings an added twinkle to his eye.

He has other hobbies also, such as astronomy, meteorology, and music. Earlier in his experience he even taught classes in astronomy; and for years he has kept an accurate record of weather conditions, maximum and minimum temperatures, barometric pressure, precipitation, and wind direction. Nothing pleases him more than to solve the more difficult cross-word puzzles; he is never satisfied to give up until he has searched every available reference. His love and appreciation of the finer types of music was expressed for many years in his association with the Handel and Hayden Society of Boston.

His long connection with the Joint Committee on Concrete and Reinforced Concrete deserves especial mention. Although naturally later research and further study have made possible a number of changes in views, its reports as a whole have stood the test of time. They form a most valuable contribution and have had a constructive and far-reaching influence on engineering practice. It is not too much to say that the work of this first Joint Committee is one of the most important fostered by the Society.

As a Society appointee, Mr. Worcester took a leading part in the deliberations throughout its life. Administratively he was a valuable member. In methods of procedure, in organization of material, in planning and acting, he was a mainstay. An illustration of one aspect of the part he played is his motion, after a rather protracted and obstructive discussion, which had unreasonably delayed business: "I move that we sit down on the chairman and back up the professor." It was carried at once without any modification. His services were especially valuable in the later years, when he served as chairman. Patient, persistent, giving time unstintingly, he pushed the committee's work. Without him its activities might have gone on the rocks.

His character is perhaps best exemplified by his generosity, thoroughness, accuracy, and honor. No matter what the request, he always gives much more freely than he should, once he is satisfied that the situation deserves it. When a problem, whether engineering or not, baffles him, he is not satisfied to drop it until he has completely mastered it. Because of his own precision in all things he has never brooked inaccuracy or carelessness in others, but his patience and tact have endeared him to all.

Everyone has always felt free to consult him about personal problems no matter how great or how trivial, being certain of getting the best advice based on experience and keen understanding of human nature. Mr. Worcester has derived greater satisfaction from training and developing men and seeing them recognized, than from any honors bestowed upon him. Undoubtedly the greatest and most sincere tribute that could be given to him would come from the men who have known him and worked for him.

According to modern notions, J. R. Worcester has perhaps kept too close to his grindstone, has had too few vacations, and traveled too little. He belongs to an earlier generation; he was born before our Civil War, and comes from long lines of Puritan and Quaker ancestry. But it need never be doubted that, greatly as he has enjoyed his profession, his enjoyment has been still greater in his quiet home life, in his perfect marriage, in his children and grandchildren. Both his home among the cedars at the foot of Prospect Hill in Waltham and his rock tower home at the tip of Cape Ann are very dear to him. Why should he leave them?

To such a man the Society delights to reach out, to take him and acclaim him as one of the select group of Honorary Members.

For Specialists in City Planning

IN DECEMBER, each member of the Society received a copy of Manual of Engineering Practice No. 14, entitled "Location of Undergound Utilities." It is considered that this work contains all the material important to a general understanding of the problems involved. However, engineers most intimately concerned with this subject will wish to supplement this manual with a separate bulletin containing detailed examples illustrating standard practice regarding the administration of such utilities in the United States.

UTILITY TUNNEL OF THE TRI-STATE TELEPHONE AND TELEGRAPH COMPANY, IN ST. PAUL, MINN.

This bulletin has now been prepared and is available in stock to supply the expected demand. About fifteen illustrations, mostly full-page, are included, showing the arrangement of underground structures in St. Paul, Minn. (see accompanying photograph) and Washington, D.C.; standard details for manholes for power cables; and methods of repairing pavement over utility cuts and service trenches.

Numerous typical forms used in the District of Columbia and the City of Cincinnati, Ohio, include permits to make longitudinal and transverse cuts in an open street, general excavation permit for gas and electricity, and the agreement forms corresponding to such permits.

Through the cooperation of the Department of Public Works, City of Cincinnati, it has been possible to secure copies of complete "Rules and Regulations Governing the Making of Openings in Streets, Alleys, Sidewalks, and Public Ways of the City of Cincinnati, and the Manner in Which the Paving Is to Be Restored." This 16-page pamphlet is bound into, and forms part of, the specialists' bulletin.

Those who wish to secure the bulletin (numbered 1937-5, and entitled *Typical Plans and Forms for Use in Locating Underground Utilities*), should address their request to the Secretary, 33 West 39th St., New York, N.Y. The price is $4.00 (regular discount to members, 50 per cent).

Memorial to Calvin W. Rice

A BRONZE TABLET in memory of Calvin W. Rice, long a leader in engineering thought and practice, has been prepared by the United Engineering Trustees, "in appreciation of a life devoted to the ad-

vancement of the profession of engineering and of his active part in obtaining from Andrew Carnegie the gift of the Engineering Societies Building." Unveiling of this memorial was a feature of "Honors Night" at the recent annual meeting of the American Society of Mechanical Engineers. Mr. Rice had served as secretary of that society from 1906 until his death in 1934.

As a rule of the Trustees prevents the placing of memorials in the public halls of the building within five years of the death of the person so honored, the tablet will remain for the present in the custody of the American Society of Mechanical Engineers.

Committee on Conservation of Water Reports on Activities and Plans

For several years the Irrigation Division's Committee on Conservation of Water has been studying such problems as water spreading, permeability of soils, physiographical balance, absorption of precipitation, consumptive use of water, and legal status of underground waters. Bibliographies are being compiled, and several conferences of engineers, foresters, agriculturists, and research workers have been sponsored. A number of papers and reports have been published, either in regular Society publications or in mimeograph form, and others are in the offing.

The executive committee of the Irrigation Division recently authorized the formation of two sectional committees on water conservation, one in Utah and one in Arizona. The Utah committee has already been set up, with O. W. Israelsen as chairman and F. W. Cottrell and E. A. Jacob as the other members. All three are Members of the Society. The Arizona committee is still to be organized.

During 1938 the main committee plans to enlarge the scope of its activities. Work by the sectional committees will be especially emphasized, and a conference on water conservation is being planned in connection with the Irrigation Division session at the 1938 Convention of the Society in Salt Lake City.

Specific suggestions for a 1938 program of study and research are invited by Harry F. Blaney, M. Am. Soc. C.E., chairman. One suggestion already received is that the committee work on deficiencies in hydrologic data, such research to be correlated with that of the National Resources Committee on the same subject. Other suggestions are for the compilation of data on consumptive use of water by native vegetation, and on contributions to underground water supplies.

Mysterious Organization Again Active

Once again the elusive "American Society of Engineers" (note the similarity of name to that of the American Society of Civil Engineers) is issuing its "special invitations" to membership. So many inquiries have been received in recent weeks about this organization that a brief review of its activities would seem to be in order.

The American Society of Engineers, alias the American Federation of Engineers, appears to be more or less a one-man organization. It operates at present from a post-office box address in Berwyn, Ill., though at one time its "headquarters" were in Pasadena, Calif. Possibly capitalizing on the similarity of its name and badge to those of the American Society of Civil Engineers, it periodically circularizes "a limited number" of "representative engineers" in all parts of the country. Just now it is hoping that its "restricted roster" can be "completed without issuing further invitations."

Among its stated objectives is cooperation with the Founder Societies, but in the entire period of its existence its cooperation has amounted to a persistent failure to answer all inquiries addressed to it. No record of any of its publications exists—though once its president, in an expansive moment, did promise to forward a copy of "the new year book and constitution" when published.

Its prospectus lists an imposing array of "Technical Divisions" covering all branches of engineering, but not one of the "executive chairmen" of these divisions is a member of either the American Society of Civil Engineers or the American Society of Mechanical Engineers. This was not always true. A few years ago there were several well-known names on the list. However, inquiry established the fact that but one of the men so honored had ever even heard of his appointment. Within a few weeks new copies of the prospectus appeared, with the names in question blocked out with a black overprint.

For those who are still interested, it should be mentioned that the initiation fee is $25, but that a bargain rate of $5 is now available. Dues are, once again, $12 per year—indicating that the depression is over, for in 1932 "all back dues" were "canceled and forgotten" and the annual tariff was dropped to $6.

Postal authorities have been consulted on this "society," but it appears that nothing can be done unless persons who have actually lost money on it are willing to complain and prosecute. This interesting organization should not be confused with any of the several highly reputable organizations with similar names, as, for example, the Western Society of Engineers and the American Association of Engineers, which have their offices in Chicago.

Louisiana Engineers to Meet January 7–8

On January 7–8, 1938, the Louisiana Engineering Society will hold its annual meeting at the St. Charles Hotel in New Orleans, La. The opening address, to be made by J. F. Coleman, Past-President of the American Society of Civil Engineers, will be followed by an inspection trip to the Market Street power plant of New Orleans Public Service, Inc. Other addresses will deal with the design and construction of the Golden Gate Bridge, the design and installation of a 37,500-kva-capacity boiler-turbine unit, oil conservation from a refiner's viewpoint, and registration of engineers in Louisiana. The annual dinner will be held on the evening of January 8.

The Louisiana Engineering Society is composed in the main of chemical, civil, electrical, mechanical, and structural engineers. Its meeting is of importance to engineers in that section of the country and is keenly anticipated by them.

Society Year Book for 1902 Wanted

Many valuable records of Society activities and much information about individual members appear in the Year Book of the Society, issued annually in the spring. Occasionally requests are received at Headquarters for back numbers of this useful publication, and usually such orders can be filled from extra copies kept on hand. Recently, however, it was found impossible to fill a request for a copy of the Constitution and List of Members dated February 1902, since only file copies of this issue are available at Headquarters. Furthermore, inquiries among a number of second-hand book dealers failed to produce a single copy of the required number.

If any member of the Society has in his possession a copy of the 1902 Year Book, which he is willing to sell or to donate to Society Headquarters, it will be appreciated if he will communicate with Headquarters, attention of Frederick S. Crowell, Office Manager. The regular price of $2.00 will be paid for receipt of a copy in good condition.

Death of George H. Pegram, Honorary Member

Just as this issue goes to press, news is received of the death of George H. Pegram, Hon. M. Am. Soc. C.E., at the Brooklyn Hospital, New York, N.Y., on December 23, 1937. He had been undergoing treatment for some weeks, and in spite of his age continued hope was held for his recovery. He would have been eighty-two on December 29.

His life work was in rail transportation. From 1898 onward he was continuously active in the rapid transit field, having been chief engineer of the Interborough lines in New York City since 1905.

In 1917 he served as President of the Society and in 1931 was made an Honorary Member. His high standing as an engineer commanded universal respect and his warm human qualities bound him to a host of friends. A more inclusive appreciation of Dr. Pegram will appear in the February issue.

Life Members, New and Old, Receive Certificates

ON January 1, 1938, 129 more members of the Society became exempt from the payment of dues and earned the designation of Life Member. This is in accordance with the constitutional provision applying to those who are 70 years of age and have paid dues as Corporate Members for 25 years, and to those who, being less than 70, have paid dues for 35 years. The list appears at the bottom of this page.

As usual, the letters notifying the "graduating class" of their exemption brought a flood of interesting replies. This year, however, the added feature of the Life Member certificate elicited special comment. One new Life Member wrote: "Personally, I am not one who cares a great deal to either hang medals on himself or diplomas on the walls, but in this instance I shall take pleasure in making a display of this particular certificate." Another referred to the certificate as "a friendly greeting from friends of long standing," and remarked that even though it came about automatically, "there is a pleasing personal touch that appeals to me."

One recipient recalled that his first job after graduation was in New York City, and that he was a faithful attendant at the Society meetings in the old house on 23d Street. "I believe," he said, "that they had considerable influence upon keeping my ideas of professional ethics. They were an inspiration to any young member of the profession."

A Life Member from the Middle West was surprised to learn of the provision for exemption from dues, and checked up in his Year Book to make sure there was no mistake. He wrote: "I certainly wish the U. S. Government would also adopt a rule of this kind so that at a certain age we could stop paying taxes. Wouldn't that be something?"

Life Member certificates have now been sent to all Corporate Members and Affiliates who have been exempted from dues in previous years—over 800 in all. As has already been mentioned in CIVIL ENGINEERING, a large number of these certificates have been presented to the Life Members in person at meetings of the Local Sections of which they are members. The remaining 633 were mailed from the Headquarters office on December 13, with the expectation that most of them would reach their destination before Christmas. A surprising number of them went to foreign countries. The Life Members of the Society now living in Japan number 6; in the Latin American countries, including Mexico, 14; and there are two each in France, Switzerland, Norway, and Australia, 4 in England, 13 in Canada, and one each in Hawaii and Russia.

Preparation of the certificates has taken the time and attention of part of the Headquarters staff for a number of weeks. Two engrossers were engaged in lettering the names, and as fast as they were made ready, they were signed by the Secretary, and then sent by mail or express to Madison, Wis., to receive the signature of Dr. Daniel W. Mead, Past-President, in whose administration the name "Life Member" was authorized and the certificate adopted.

Many complimentary comments have been made on the appearance of the certificates, and a number of the recipients indicated that they were planning to frame them separately instead of cutting them down to fit in a corner of their earlier diplomas. The high esteem in which these men hold the Society is reflected in the following excerpts from two of their replies:

"I am now a life member of six engineering societies, the founder of one, and an honorary life member of two clubs, but I value none more than the American Society of Civil Engineers."

"My mind runs back to the occasion when I was elected to membership, and to the pride I then had, never since dimmed, in my admission to the premier society of the profession—to which I have been devoted for more than half a century."

It is of interest to note which of these Life Members has been in the Society the longest time. The honors for Corporate Membership should go to William Covington Gunnell, of Washington, D.C. He was born in the year 1841 and joined the Society in the grade of Member in February 1877. His exemption from dues dates from the year 1912. Closely following are the names of C. Frank Allen, who has been a Member since February 6, 1878, and C. E. Billin, who became a Junior on April 5, 1876, and a Member July 3, 1878. If the longest continuous connection with the Society is taken into account, the palm should be awarded to Henry Newton Francis, who was elected a Junior on March 1, 1876, and became a Member on November 7, 1888.

MEMBERS BECOMING EXEMPT FROM PAYMENT OF DUES AS OF JANUARY 1, 1938

Ackerman, John Walter
Alderson, Algernon Brown
Allan, Thomas John
Allen, Walter Hinds
Atkinson, Asher
Baker, Shirley
Bantel, Edward Christian Henry
Bartoccini, Astolfo
Bassel, Guy Mannering
Bayliss, John Yancey
Beeler, John Allen
Blackwell, Francis Ogden
Bloom, J. George
Boughton, Will Hazen
Bowen, Oscar Sidney
Bowerman, Horatio Bevan
Bradshaw, Sam Wigfall
Breed, Charles Blaney
Brower, Edward Sylvester
Brown, Frank Dudly
Brown, Maurice Fritchley
Burgess, George Heckman
Burley, Harry Benjamin
Carpenter, Allan Wadsworth
Clarke, George Calbraith
Connick, Harris De Haven
Cosby, Spencer
Coutlee, Charles Robert Foran
Crew, Charles Corwin
Croswell, Thomas Henry
Cruise, Edgar Dudley
Davis, Frederick Calvin
Davis, George Henry
Davis, John Rose Wilson
de Vou, James Laird
Eld, Charles John, Jr.
Ellms, Joseph Wilton
Emerson, Guy Carleton
Fargo, William Gilbert
Fenn, Robert Willson
Fenn, William Henry
Fetherston, John Turney
Field, Frederick Elbert
Field, John Ellis
Fraser, Charles Edward
Frazier, James Welch
Frederickson, John Henry
Frost, George Sherman
Gales, Robert Richard
Gifford, Robert Ladd
Goodwin, James Bowman
Granbery, Julian Hastings
Green, Charles Samuel
Greenfield, Robert Arthur
Groat, Benjamin Feland
Hanna, Frank Willard
Harby, Isaac
Hindes, Stetson George
Hunt, Carlton Eugene
Ilsley, Arthur Benjamin
Johnson, Arthur Newhall
Kimball, William Hale
Knapp, Hermann Meriwether
Kummer, Frederic Arnold
Langthorn, Jacob Stinman
Lawson, Thomas R.
Lewis, Clifford, Jr.
Lewis, William Willett
Lindsey, John Brown
Little, George Kerr
Look, Moses Jerome
Macy, Elbert Clyde
McConnel, Wilfred Gillette
McFetridge, William Sutton
McKay, George Albert
McNeal, John
Manahan, Elmer Gove
Mansfield, Walter Huntley
Manton, Arthur Woodroffe
Marshall, Robert Bradford
Matheson, Ernest George
Maximoff, Sergius Pavlovitch
Moss, Castle Prentice
Neville, Colone Will Jackson
Newton, Albert William
Nyeboe, Marius Ib
Ogden, James Clarence
Orrok, George Alexander
Paine, Hibbard Atwill
Parker, Charles Frederick
Parsons, Charles Edward
Pfau, Julius Welch
Phillips, Jasper Marion
Pope, Willard
Ramsey, Guy Robert
Rhines, George Volney
Rothrock, William Powell
Sackett, Robert Lemuel
Schwiers, Frederick William, Jr.
Senior, Samuel Palmer
Shepardson, John Eaton
Shoemaker, Marshall Ney
Skelly, James William
Skinner, John Franklin
Smith, Francis Betts
Spaulding, Charles Lincoln
Stayton, Edward Moses
Stehle, Felix Charles
Strawn, Thomas Corwin
Swift, William Everett
Thompson, Mackey James
Tidd, Arthur Warren
Treadway, Howard Platt
Van Loan, Seth Morton
Van Norden, Ernest Maitland
Van Pelt, Sutton
Verveer, Emanuel Louis
Waldron, Samuel Payson
Weiss, Andrew
Wendt, Edwin Frederick
Wheeler, Ralph Norman
White, Lazarus
Wilkinson, Thomas Lee
Williams, Samuel Daugherty, Jr.
Wilson, Charles Beatty
Wilson, Everett Broomall
Wiltsee, William Pharo
Winsor, Frank Edward
Wolfe, Christian John

Early Presidents of the Society

XXII. Mendes Cohen, 1831–1915
President of the Society, 1892

Readers are urged to keep in mind that their cooperation in supplying photographs, anecdotes, and other data helps to make these sketches readable and informative. The next three articles will deal with William Metcalf, William Price Craighill, and George Shattuck Morison.

Those who incline to the idea that the engineer is a "type" would be hard put to it to classify Mendes Cohen. An acknowledged leader of his profession, he nevertheless retired from active practice when about 45, and spent most of the remaining 40 years of his life in historical research, promotion of the arts, and service to charitable and educational institutions. That he retained his prominence in engineering circles, however, is witnessed by his election as President of the Society some 16 years after his "retirement," and by his subsequent appointments to important federal and municipal engineering boards.

Mendes Cohen
Twenty-Second President of the Society

The family of Mendes Cohen was prominent in Bavaria in the eighteenth century. Its first representative in the United States settled in Lancaster, Pa., in 1773, and took part in the Revolutionary War. The family later moved to Richmond, Va., and thence to Maryland, where its members soon established themselves in trade and commerce and banking. David I. Cohen, the father of Mendes, was one of the seven persons who founded in 1844 the second Baltimore Stock Board, which later became the Baltimore Stock Exchange. He also helped finance many of the early public works of this country.

Mendes Cohen received his schooling from private tutors, and at the age of 16 entered the works of Ross Winans, the builder of early American locomotives, where he learned the trade of machinist and acquired a thorough knowledge of drafting and locomotive construction. There was a close connection between this firm and the Baltimore and Ohio Railroad, and young Cohen soon became acquainted with many of the early engineers of the latter organization.

In 1851 he himself became an assistant engineer on the Baltimore and Ohio Railroad, and almost immediately had the good fortune to serve under Benjamin D. Frost, M. Am. Soc. C.E., on the construction of the Broad Tree tunnel (about 164 miles west of Cumberland). At that location, while the work was in progress, it was necessary to operate trains over a temporary track with a 6 per cent grade and curves of 300-ft radius. Such grades and curves were then absolutely without precedent, and excited astonishment throughout the railroad world. The experience gained there stood Cohen in good stead a year or so later, when he distinguished himself by working out the method for handling the traffic on a 10 per cent temporary grade over the Kingwood tunnel. This feat was referred to 40 years later in *Engineering News* as still remaining "one of the most remarkable and exceptional performances in railway annals."

For a time Cohen was assigned to the motive power department, in a position that later would probably have been called assistant superintendent of motive power. At that time, however, there was a good deal of chaos in the distribution of official duties, and men were given one or another task as their qualifications seemed to warrant. Doubtless because of his experience in the Winans shops it fell to Cohen to solve the problem of adapting the wood-burning locomotives to the use of coal. He prepared a comprehensive report on that subject in 1854.

In 1855, when only 24 years old, Cohen had achieved such prominence that he was made assistant superintendent of the Hudson River Railroad (now a part of the New York Central). Six years later he succeeded General McClellan as operating head of the Ohio and Mississippi Railroad, which ran from Cincinnati to St. Louis. He soon was made president of that road, and during the Civil War he and Octave Chanute, his chief engineer, had many a difficult problem to solve in the important task of transporting troops.

There followed engagements as superintendent of the Reading and Columbia Railroad and as comptroller of the Lehigh Coal and Navigation Company. When the latter's lines were leased to the Central of New Jersey in 1871, Cohen retired from active official duties—at the age of 40. The retirement, however, was brief. A year later he was persuaded to take the presidency of the Pittsburgh and Connellsville Railroad, and he remained there until the road was consolidated with the Baltimore and Ohio in 1875.

This time his "retirement" was permanent, though actually it amounted only to shifting his efforts to work that had a stronger personal appeal. Financially independent, he was now able to devote himself entirely to his historical studies and to the welfare of the city of Baltimore.

Among the numerous state historical societies, that of Maryland is outstanding, and Cohen's contributions to its collections and publications were of inestimable value. He served for 21 years, beginning in 1882, as its secretary, and for 9 years (1904–1913) as its president. He also contributed generously to the guaranty funds that made possible the publication of the *Maryland Historical Magazine*. With great pains he traced many a lost document and record, purchased them, and restored them to the state. Most noteworthy among these were the "Calvert papers," which shed important light on the provincial history of Maryland, and the "Carroll papers," consisting of more than 700 letters and documents pertaining to the famous "Charles Carroll of Carrollton." Also interesting, though less important, was Cohen's recovery of a replica of the Great Seal of Maryland, which had somehow gotten into the hands of a dealer in London. Considerable diplomacy and work was involved in getting it back to Annapolis.

Cohen also helped to found the American Jewish Historical Society, and was for a long time a member of its executive council.

A man of wide general cultivation, Cohen took an interest in all the artistic, musical, and intellectual pursuits of his fellow citizens in Baltimore, and in the institutions that fostered them; he was an active trustee of the famous Peabody Institute, and a member of the Municipal Art Commission from 1892 until his death.

But he was active in more prosaic fields as well, serving as chairman of the Baltimore Sewerage Commission from 1893 to 1900. Cyrus Adler states that it was through his ability and persistence that the modern system of sewerage in Baltimore was adopted and put into effect in 1906. Again, in 1894, he was appointed by President Cleveland as member of a board to report on a route for the Chesapeake and Delaware ship canal.

On Cohen's death the *Jewish Comment* said editorially: "We are so used to thinking of the American Jew as the successful business man, mildly interested in his synagogue, attached to his club and devoted to his office first, last, and all the time, that we have seldom had the vision of a Jewish gentleman like Mendes Cohen, as a type worthy of that appellation, and of emulation."

Elsewhere in the same paper, a contributor wrote: "He served not only the city and the state unselfishly and devotedly; he likewise served his own people. He ever remained a loyal Jew, a steadfast follower of the religion and the traditions of our people. . . . He accepted the laws and the observances of our religion, not only as a confession of faith, but as a sacred duty, as a mode of life."

It is of interest to note that Cohen once resigned the presidency of a railroad because figures he had supplied were altered before being presented to the stockholders. It is not clear from the data at hand to what road this refers.

Cohen died on August 13, 1915, survived by his wife. Their only child, a daughter, had died several years before.

Regional Conference of North Carolina Student Chapters

THE THIRD annual conference of the Student Chapters in North Carolina was held at North Carolina State College, Raleigh, N.C., on November 20, 1937. Sixty members of the Student Chapters at the University of North Carolina, Duke University, and North Carolina State College were present, together with three Faculty Advisers.

Following registration in the morning, the group went to the headquarters of the State Highway Department, traveling in automobiles furnished by the North Carolina Section. Visits wer made to the bituminous and concrete-testing laboratories, the bridge and design department, and the accounting department. Next, under convoy of a state police escort, the highway department shops and soil mechanics laboratory were visited, after which the party returned to State College for luncheon as guests of the host Chapter.

Following the luncheon a formal welcome was extended by W. A. Edwards, president of the regional conference organization, followed by responses from the two guest Chapters. The principal address was by J. L. Becton, president of the North Carolina Section. He announced prize awards to be given at the annual spring convention in Pinehurst, N.C., for the four best student papers. He also announced a novel plan for introducing members of the Chapters to the members of the Section. A very cordial invitation was extended to all students to attend the convention next spring.

Field Secretary Jessup of the Society was also present and spoke.

Art Helps Photography

As Shown by Manipulations Required for Preparing "Civil Engineering" Cover

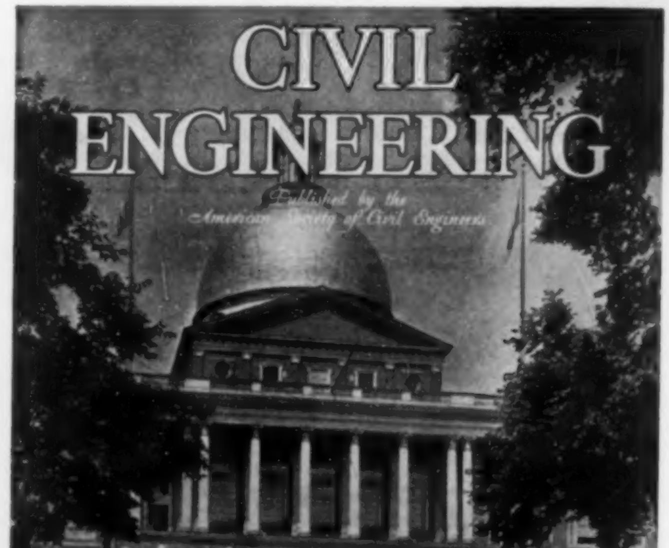
WHILE the methods used in preparing illustrations for reproduction in CIVIL ENGINEERING are well known to those in the publication field, the questions asked by Society members who visit the editorial department indicate a wide interest in such operations as rephotographing, retouching, "stripping" of negatives, silhouetting, vignetting, tooling, notching, deep-etching, re-etching, highlighting and the like. Among these operations, which make possible the halftones appearing in CIVIL ENGINEERING each month, retouching seems to be the most fascinating.

Under the head of retouching come such tricks as removing unsightly objects in otherwise acceptable photographs, "bringing in" light-struck areas, cleaning up blemishes due to imperfect photographic negatives or prints, "toning down" or "bringing up" certain details for better effects in the halftone reproduction, and sundry other operations, some of which are described herein.

To show the importance which retouching plays in the preparation of an illustration there is reproduced on this page the unretouched photograph which was chosen for the "full-bleed" cover of the December issue to provide a "Boston atmosphere" for the Boston Meeting papers which were reported therein. To the right of this unretouched photograph is a halftone reproduction of the completed cover. Many questions have been prompted by this display: "How did you 'stretch' the picture over the white border at the top of the original photograph?" "What became of the man along side of the taxicab in the foreground of the picture?" "How is the white lettering put on the photograph? Is it lettered on by hand each time?" These questions are all answered by explaining some of the intricacies of retouching and the use of one or two engraving tricks, as adapted, by the editors in cooperation with the Society's engravers, to this particular sort of problem.

A commercial artist's airbrush—small brother of the cement

Unretouched Original Photograph



As Retouched and Used for December Cover

TEXT OF STORY EXPLAINS THE DISAPPEARANCE OF THE MAN IN CENTER OF PICTURE, ELIMINATION OF WHITE BORDER AT TOP OF ORIGINAL PHOTOGRAPH, AND THE STEPS IN "SETTING-UP" COPY FOR ENGRAVING

gun—is used for shading effects on photographs, for darkening an area, for blowing in cloud effects, or for "cleaning up" a sky when mottled, streaked, or spotted. Using this tool, new details were added and the cover photograph was extended up over the white margin at the top in order to get the proper proportions without having to crop too much off the sides. It may be noted too that the

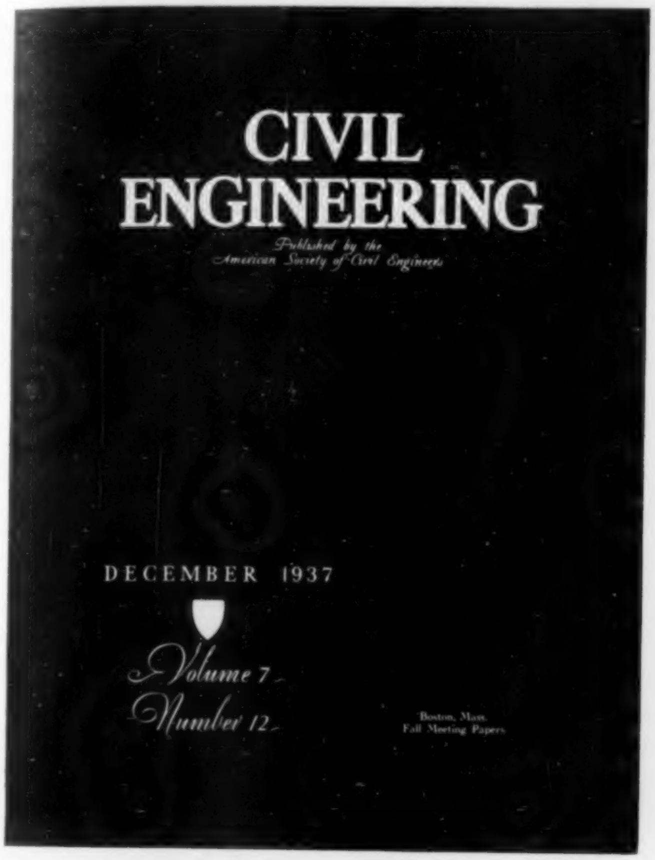


FIG. 1. LINE COPY, FURNISHED TO THE ENGRAVER ALONG WITH THE RETOUCHED PHOTOGRAPH

A Line Negative Is Made Directly from This and Combined with the Halftone Negative in One Step of the Process of Making the Metal Printing Plate, Eliminating Extra Engraving Expenses

lower left-hand corner of the photograph was likewise darkened so that the white over-lettering would show to better advantage. The leaves of the tree in the upper corners of the photograph were put in by a camel's hairbrush and opaque watercolors aided by a little stippling with a china marking crayon. Similarly, the man in the foreground was prevailed upon by the artist to kindly "move on" out of view and thus help the composition. This was accomplished by the simple expedient of painting in the background; for instance, the window detail was completed and the stripes on the taxi were made continuous, thus obliterating the man by means of a wet brush and opaque watercolors.

The white lettering on the cover is blanked out by combining the halftone negative with a line negative made from the copy (Fig. 1) which is set up for that purpose. The essential parts of this copy are held from month to month and the new data revised as needed before sending to the engraver. The blue border around the white letters of the words CIVIL ENGINEERING, and the blue of the Society badge which fits into the white area that has been dropped out of the halftone plate, are printed from separate zinc etchings made from special prepared copy. Electrotypes of these two "blue plates" are held from month to month by the printer as there is no change in their size or details.

While retouching is used to improve the composition of a photograph as a mechanical expedient for "adding to" a photograph and for "cleaning up" a print, it is not employed to "fake" a picture which is given primarily for information and which depends upon its photographic authenticity to present its argument in supplementing the text. In other words, it is well to distinguish between the legitimate use and the possible abuse of this valuable tool.

Great Plains Student Conference

REPRESENTATIVES from Student Chapters in North Dakota South Dakota, Wyoming, and Montana gathered at Rapid City, S.Dak., on November 4 and 5, 1937, in the first Student Chapter regional conference held in that area. By chance, the conference dates coincided with the dates of the annual convention of the South Dakota Society of Engineers and Architects, which extended a cordial invitation to the students to attend all its meetings.

Perhaps the most unique feature of this conference was the distance traveled by the student representatives. Those from the University of Wyoming had a round trip of 704 miles; from the University of North Dakota, 1,350 miles; from North Dakota State College, 1,080 miles; from Montana State College, 1,180 miles; and from South Dakota State College, 800 miles. Four of the six Faculty Advisers were present. The student attendance was 40, of whom 25 were visitors from out of town.

South Dakota School of Mines was host to the visitors. On Thursday the students attended meetings of the South Dakota Society, including its banquet Thursday evening.

The first session was called to order at 8:30 a.m. on Friday, November 5, at the School of Mines, by Donald Johnson, president of the School of Mines Chapter. He introduced Dr. J. P. Connolly, president of the South Dakota School of Mines, who welcomed the representatives and invited them to be the guests of the School at a banquet, a football game, and a reception, all to be held that evening.

There was a brief address by R. C. Gowdy, Vice-President of the American Society of Civil Engineers. He was followed by Hunter W. Hanly, chairman of the Society's Committee on Student Chapters, who brought special greetings from E. M. Hastings, member of the committee in charge of the Western Region. A number of corporate members of the Society were also present.

The representatives from the Chapter at the University of Wyoming then presented a draft of a constitution for the permanent organization of the regional conference. This was discussed item by item and finally adopted in its original form. Under the new constitution, the following officers were then elected.

President—Robert Peterson, North Dakota State College
Vice-President—Robert Hastings, University of Wyoming
Secretary-Treasurer—Robert Simmons, South Dakota State College

William Bonnell, representative from the South Dakota State College Chapter, extended an invitation to hold the next conference at Brookings, S.Dak., which invitation was accepted. The final action of the morning session was to adopt resolutions prepared by a resolutions committee, appreciative of the hospitality shown by the South Dakota School of Mines and its Student Chapter as well as of others who had made the conference possible.

During the afternoon, inspection trips were made through the School of Mines and also through the surrounding Black Hills.

In the evening the students were guests of the School of Mines at dinner, following which brief but lively discussion was held on the procedure followed by the various Chapters at their meetings. This exchange of ideas proved to be of great value to all the representatives. The group then adjourned to the football game, which was followed by a reception, thus bringing to a close an extremely effective first conference of the Student Chapters in the Great Plains area.

Particular commendation is due to Professor Dake and his local committees that arranged the meeting, to the various subcommittee members from each campus that cooperated throughout the conference, and to the secretary of the conference, Robert Simmons, who prepared a very complete 11-page report, which was subsequently mimeographed and distributed to all the Chapters.

Passage of Texas License Law Result of Energetic Drive by Local Section

BEHIND the enactment, in Texas last spring, of a professional engineers' license law, is an interesting story of Local Section activity. The full report has just been received at Headquarters.

Some 15 years ago a number of the charter members of the Texas Section inaugurated a movement to enact such a law, but, "not being well organized and trained in the intricacies of political pro-

cedure," the proposal failed. By 1934 Texas found herself completely surrounded by states that had licensing laws, and "persons who could not obtain a license to practice engineering in these states were flocking to Texas and lowering not only the standards of the profession but the revenues of the local engineers." The Section thereupon began its second drive for an enactment.

A legislative committee was appointed, consisting of A. J. McKenzie, chairman; Grayson W. Gill, J. M. Howe, Don Lee, C. M. Davis, and T. B. Worden. This committee immediately employed attorneys and proceeded to draft a bill, following as nearly as possible the well-known "Model Registration Law." It was introduced in the State senate, but ultimately died on the calendar, on account of other pressing legislation, and the fact that the engineering profession did not yet "command sufficient respect and influence with the members of the legislature and other public officials" to secure its passage.

Accordingly, another effort was begun in the fall of 1936. The legislative committee was increased to include D. L. Lewis, John A. Norris, J. H. Brillhart, E. N. Noyes, O. H. Koch, Datus E. Proper, and John S. Fenner. To increase its prestige and influence, it invited the president of each engineering society in the state to designate a representative to sit with it; and the response to these invitations was unanimous. Next the original bill was carefully revised to meet the objections that had developed and to make other improvements. It was introduced in both houses at approximately the same time, and ex-Senator W. M. Harmon was engaged to guide it to passage. Meanwhile, "the entire state was circularized and every member of the legislature was contacted in person, or by personal letter."

Little difficulty was encountered in the Senate, "but it was very evident that engineers did not stand particularly well with the members of the House. . . . Some members employed every trick at their disposal to prevent its passage." However, after appending some twenty amendments, several of which almost made the bill useless, the House passed it, and it went to conference.

There "Mr. Harmon did a wonderful job compromising and reconciling the differences between the bill passed by the Senate and the one passed by the House." Most of the objectionable features, including the ruinous amendments, were eliminated; the conference committee report was accepted by both houses; and the bill was signed by the governor on May 29, 1937.

The report of the Section's legislative committee, from which the preceding quotations are taken, concludes:

"Like every worth-while accomplishment, the enactment of this law carries with it a very definite responsibility on the part of the engineer, not only to the profession, but to the public as well. . . . Above all, it should be kept constantly in mind, as has been well said by Mr. Charles A. Bardsley, president of the California Bar Association, that the public is going to be served by those who serve it best, and that the same public which has given you an exclusive right to practice engineering can take that right away, or modify it at any time, and in the long run, you are going to retain that exclusive right only as long as you can serve the public better than anyone else."

Original Records on Filtering Materials

A NOTABLE progress report on Filter Sand for Water Purification Plants, occupying 38 pages, was published in the December 1936 PROCEEDINGS; and in 1937, "Filtering Materials for Sewage Treatment Plants" was issued to members as Manual of Engineering Practice No. 13, containing 40 pages.

It is not easy to visualize the great mass of correspondence and test data assembled to support these 78 pages of published material. Through the courtesy and painstaking care of the Sanitary Engineering Division's Committee on Filtering Materials, the Society's Technical Library (which is merged with the Engineering Societies Library, 33 West 39th Street, New York, N.Y.) has been made richer by the acquisition of ten volumes of reports and letters on this subject. Members of the Society who have work to do in this field can consult the entire file by simply applying at the Library desk. Complete test results are given, in manuscript form, for such important plants as those at Chicago, Ill.; Cleveland, Ohio; Baltimore, Md.; Richmond, Va.; Racine, Ill.; Springfield, Ill.; St. Louis, Mo.; Tulsa, Okla.; Washington, D.C.; Omaha, Nebr.; Toronto, Ont., Canada; and Kansas City, Mo.

As a testimonial to the tremendous amount of work done by the committee, this collection of records speaks for itself.

Memoirs of Deceased Members Available

FROM TIME to time during the past year, the Committee on Publications has made Memoirs of deceased members available in the form of preprints of TRANSACTIONS. All those that were announced in CIVIL ENGINEERING, to a total of 102, were published in Volume 102 of TRANSACTIONS which was issued to the membership late in 1937. Since that time a limited number of the following preprints from Volume 103 have been prepared and complimentary copies will be forwarded on request:

Robert Adam	1866–1937
James Bonnyman	1879–1937
Charles Brossman	1877–1937
Joseph Dunton Brown	1884–1937
Melvin David Casler	1881–1937
Arnold Goodwin Chapman	1884–1937
Melville Fisk Clements	1875–1937
Erle Long Cope	1883–1937
Thurston Carlyle Culyer	1864–1936
Alfred Douglas Flinn	1869–1937
Abraham Getmon Gideon	1871–1936
Clarence Scott Howell	1875–1936
Thomas Herbert Jackson	1874–1937
Winfred Miller Kallasch	1877–1937
Ludwig Theodore Maenner	1863–1937
Fred Bailey Oren	1880–1936
Franklin Calhoun Pillsbury	1869–1937
Clarence DuBois Pollock	1871–1937
Hiram Newton Savage	1861–1934
Walter Justin Sherman	1854–1937
John Kenneth West Shibley	1882–1937
Bernhard Alexander Smith	1863–1936
Edward Everett Stetson	1882–1937
Harry Randolph Talcott	1861–1937
Robert Bruce Tinsley	1883–1937
John Jervis Vail	1877–1936
Leonard Chase Wason	1868–1937
Willard Olney White	1876–1937
Allan Sheldon Woodle, Jr.	1878–1937

Honorary Degrees as a Measure of Professional Progress

ELSEWHERE in this issue is the notice of the granting of two additional honorary degrees recently, to Herbert Hoover, Hon. M. Am. Soc. C.E., the degree of doctor of laws from Colby College; and to Robert Linton, M. Am. Soc. C.E., that of doctor of science from Washington and Jefferson College. These additions increase the number reported during the current year to 16 members of the Society.

Some one will doubtless observe, and correctly, that mere quantity of honorary degrees in a profession is not important of itself. While this is true, yet the condition or the active trend is indicative of something much deeper. Over a period of years the number has been increasing; last year it was only nine and this year the number of names has almost doubled.

Surely, if nothing else, this is a striking indication of an enlarging appreciation of the civil engineer. Every member will take pride in the fact.

Appointments of Society Representatives

EUGENE L. MACDONALD and RUDOLPH P. MILLER, Members Am. Soc. C.E., have been reappointed Society representative and alternate, respectively, on the Council of the American Standards Association.

Preview of Proceedings

By Harold T. Larsen, *Editor*

From all present appearances, the January issue of "Proceedings" will be among the largest issued by the Society in several years, both as to the number of papers and quantity of technical information. In addition to a large number of discussions, there will be four individual papers and a symposium of eight papers, making twelve in all. The subjects will range all the way from stream pollution, suspension bridges, bridge floors, and structural analysis, to hydraulic pressures due to water hammer. Discussions and closing discussions on many of the two dozen current papers will increase this range of interest still further.

Symposium on Stream Pollution in the Ohio Basin

Interest in the abatement of stream pollution is developing rapidly, in many sections, and this is especially true in the Ohio River basin, where some 2,000,000 people depend for their water supply on streams highly charged with industrial wastes and sewage. The present symposium is designed to focus attention on the particular problems of that region, and to emphasize the need for comprehensive planning in their solution. Its value, however, is not limited to the Ohio basin, for the principles set forth are equally applicable wherever stream pollution is demanding attention.

There are eight papers in the symposium, including the foreword by George E. Barnes, M. Am. Soc. C.E. In "Stream Pollution Surveys," H. W. Streeter, M. Am. Soc. C.E., describes methods for determining the extent of pollution and gives the results of such a survey on the Ohio, together with suggestions for minimum standards for river conditions. Next, C. E. Ryder explains the uses of the Pymatuning Reservoir, emphasizing particularly its value in augmenting the dry-season flow of the Shenango and Beaver rivers, for dilution purposes. The paper by W. L. Stevenson, M. Am. Soc. C.E., describes the duties of state departments of health, municipalities, and water-works officials in time of flood, the suggestions being based largely on the efficient operations carried on in Pennsylvania in the flood of 1936. A picture of sanitary conditions in the basin as a whole is presented by E. S. Tisdale, who in addition gives valuable data on the mine-sealing program that is reducing the acid load on the river. Details of the conditions at Pittsburgh, and of the sewage disposal plan proposed by the Metropolitan Drainage Survey, are next outlined by D. E. Davis, M. Am. Soc. C.E. Cincinnati's problems are discussed by J. E. Root, M. Am. Soc. C.E., with special emphasis on the need for intercity and interstate cooperation in their correction. The concluding paper, by Abel Wolman, M. Am. Soc. C.E., is concerned with the medium through which comprehensive planning and adequate financing may be secured.

This symposium was sponsored cooperatively by the Sanitary Engineering Division and a special committee of the Cleveland Section, and was presented at the 1936 Fall Meeting of the Society at Pittsburgh, Pa. Brief summaries of the papers appeared in the January 1937 issue of Civil Engineering.

Preliminary Design of Suspension Bridges

A rapid and accurate method of analysis for the preliminary design of the stiffening trusses of suspension bridges is presented in this paper on "Preliminary Design of Suspension Bridges" by Shortridge Hardesty and Harold E. Wessman, Members Am. Soc. C.E. The method demonstrates clearly the related functions of cable and stiffening truss, emphasizing the fact that the cable is the major structural element and that the truss is added to cut down undesirable grade changes. Moreover, the various factors which contribute to the final moments and deflections in the stiffening truss are so classified that the designer is able to obtain a clear picture of the relative contribution of each to the total.

Certain types of statically indeterminate structures are hybrid in their action. Every time a change is made in dimensions or design sections, a change takes place in the moments or forces acting upon such structures. The stiffening trusses of a suspension bridge behave in this manner. Regardless of arbitrary limits imposed upon deflections or grade changes, the designer not only has a choice of many different stiffening trusses: in some cases, with large dead load and relatively small live load, he may omit them entirely, as was done in the George Washington Bridge. There is a definite need for a rapid method of analysis for preliminary design studies of stiffening trusses, so that the engineer may form some intelligent conclusions as to what happens when he varies the depth or changes chord sections, or selects a new sag ratio, or investigates a light-weight floor with higher unit cost, or moves main towers and anchorages to different relative positions.

In the proposed method, the maximum moments at the quarter point and the center of the main span are computed in two major steps. First, the deflections of an unstiffened cable under partial live load for various ratios of live load to dead load, are computed on the assumption that the cable length is unchanged and the tower tops do not move. An average value of load length is used, which value was determined from a study of load lengths giving maximum moments at the quarter point and center of the stiffening trusses of several actual bridges.

The effect of adding the stiffening truss is then considered. Evidently, the truss will attempt to conform to the curve of deflection of the cable. It will reduce the deflection, however, and will assume some compromise position depending upon its stiffness. The bending moment taken by the truss in its attempt to conform to the deflected cable will be a function of the maximum deflection of the cable at certain points and the truss stiffness. A trial moment of inertia is used and corrected later if found necessary. A single numerical coefficient accounts for non-uniform suspender loading. The moment is evaluated primarily from the important consideration that, if the cable is kept from assuming its natural position as an unstiffened cable, the stiffening truss must provide the bending moment required to hold the cable in its restrained position.

Finally, the changes in the length of the cable due to live load or rise and fall of temperature, and the sag changes caused by movement of the tower tops or by the interaction between side spans and main span, are combined into one change in the center sag. This lowers or raises the truss, causing a moment which is added algebraically to the moment obtained in the first step.

The changes in center sag of the side span are necessarily found in order to evaluate loading conditions governing the main span. From these sag changes, it is a simple matter to compute the maxi-

Wide World Studios

The Triborough Bridge, New York City

mum positive and negative moments at the center of the side-span trusses.

The new method is demonstrated in detail by applying it to the Triborough Suspension Bridge, shown in the accompanying photograph. Final results obtained by the new method are also compared with those obtained by the deflection theory for a number of suspension bridges, including the San Francisco–Oakland Bay Bridge. The last-named structure is also used as a basis to show how changes in the moment of inertia of the stiffening trusses cause important changes in the bending moments resisted by the trusses.

STRUCTURAL BEHAVIOR OF BATTLE DECK FLOOR SYSTEMS

Since late in 1934 the behavior of battle deck highway flooring has been the subject of intensive research at the Fritz Engineering Laboratory of Lehigh University. The final results are being reported in a paper entitled "Structural Behavior of Battle Deck Floor Systems" by Inge Lyse, M. Am. Soc. C.E., and I. E. Madsen, Jun. Am. Soc. C.E. This study includes tests on one full-sized floor panel and four models constructed to a scale of 1 to 3. The paper contains the tabulated results of computations from the laboratory readings and illustrations to support their several conclusions regarding this type of flooring.

RELATIVE FLEXURE FACTORS FOR ANALYZING CONTINUOUS STRUCTURES

In PROCEEDINGS for October 1934, a paper by R. W. Stewart, M. Am. Soc. C.E., entitled "Analysis of Continuous Structures by Traversing the Elastic Curves" was presented for discussion. A paper ("Relative Flexure Factors for Analyzing Continuous Structures") by the same author, which is in the nature of a sequel, presents a method for analyzing beams and certain types of frames. Its basic principles are the same as those of the former paper, but the new paper gives a much more convenient and effective procedure for applying these principles and extends their application to a greater variety of structures. Although the fundamental principles are given briefly in the later paper, some students will find it advantageous to read the earlier paper as a background for an intimate understanding of the later contribution in this field.

The improved procedure carries the method an important step forward by avoiding the use of simultaneous equations. The solution of a problem begins at the part of a structure remote from the loaded member and carries the computation towards the loaded member by a direct method which may be carried to any desired degree of accuracy in one operation. By this important paper, Mr. Stewart has demonstrated that the construction of the elastic curve as a traverse is an important and basic feature of the geometry of deflections and the analysis of continuous structures.

WATER-HAMMER PRESSURE IN COMPOUND AND BRANCHED PIPES

In the field of hydraulics, the available literature on water hammer will be greatly enhanced by the publication of the forthcoming paper by Robert W. Angus, entitled "Water-Hammer Pressures in Compound and Branched Pipes."

In this paper Mr. Angus goes into considerable detail in describing the use of graphical methods of solving the more complex water-hammer equations. The general theory was first presented in 1935 to the Engineering Institute of Canada, and the present paper, for a simple case, leads directly into the analysis of water-hammer pressure in compound and branched pipes.

The paper contains 20 line drawings illustrating the application of the method to parallel pipes, pipes with dead end, surge tanks in the distribution system, pipes leading from reservoirs having two branches (each discharging water), the effect on turbines and draft tubes of closing the gate, and the examination of a pumping system in which the pressure is so low as to cause the columns to separate.

In all of these cases, the variation of pressure and velocity with time is found for various points in the system. All of the problems cited, and many more, may be solved both accurately and quickly, on the drafting board by the method proposed by Professor Angus. The right solution by analytical means is almost impossible.

CHANGE IN POLICY

With this issue "Preview of PROCEEDINGS" retires from the scene. In the interest of economy of space it has been decided, in the future, to print merely the titles and authors of forthcoming papers, with pithy summaries in epitome style. It is proposed to offer this condensed feature, possibly in display form, under the title "Forecast for — —— — PROCEEDINGS."

News of Local Sections

Scheduled Meetings

BUFFALO SECTION—Luncheon meeting at the Buffalo Athletic Club on Jan. 11, at 12:15 p.m.

CENTRAL OHIO SECTION—Luncheon meeting at the Chittenden Hotel on Jan. 13, at 12 m.

CLEVELAND SECTION—Annual dinner meeting at the Chamber of Commerce on Jan. 17, at 6:30 p.m.

COLORADO SECTION—Dinner meeting at the University Club in Denver on Jan. 10, at 6:30 p.m.

LOS ANGELES SECTION—Meeting on Jan. 12.

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building in New York City on Jan. 12, at 8 p.m.

NORTHEASTERN SECTION—Meeting at the Engineers Club in Boston on Jan. 24, at 6 p.m.

PHILADELPHIA SECTION—Dinner meeting at the Engineers Club on Jan. 13, at 6 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:10 p.m.

ST. LOUIS SECTION—Luncheon meeting at the Mayfair Hotel on Jan. 24, at 12:15 p.m.

SAN DIEGO SECTION—Meeting on Jan. 27.

SAN FRANCISCO SECTION—Meeting of the Junior Forum on Jan. 18.

SEATTLE SECTION—Dinner meeting at the Engineers Club on Jan. 31, at 6 p.m.

SPOKANE SECTION—Luncheon meeting at the Crescent Tea Room on Jan. 14, at 12 m.

TACOMA SECTION—Dinner meeting at the Tacoma Hotel on Jan. 10, at 6:30 p.m.

TENNESSEE VALLEY SECTION—Supper meeting of the Knoxville Sub-Section at the University of Tennessee Cafeteria on Jan. 6, at 6:15 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Dallas Athletic Club on Jan. 3, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on Jan. 8, at 12 m.

Recent Activities

ALABAMA SECTION

A meeting of the Alabama Section took place at the Tutwiler Hotel in Birmingham on November 23. During the business session several committee reports were discussed, and new committees were appointed. The action of the Executive Board in establishing annual prizes of cash for the two best papers presented by Student Chapter members at the University of Alabama and Alabama Polytechnic Institute was also discussed. Certificates of life membership were presented to William B. Allen and John Richards Pill. Then Lyle F. Bellinger, Vice-President of the Society, gave a talk on the finances of the Society. He was followed on the speakers' platform by John F. Tribble, materials engineer for the Alabama State Highway Department, who read a paper on "The Application of Soil Studies to Subgrade Treatment and Base Construction."

BUFFALO SECTION

A luncheon at which certificates of life membership were presented to 13 members of the Society was sponsored by the Buffalo Section on November 9. This affair, which took place at the Buffalo Athletic Club, attracted an attendance of 25. Certificates were presented to Walter McCulloh, Frederick K. Wing, George B. Bassett, John W. Cowper, Schuyler Hazard, and Francis J. Tresise. After the meeting certificates were mailed to the following members who were unable to attend the luncheon: John N. Ostrom, Douglas Cornell, Charles J. H. Moritz, Harry L. Noyes, Leslie J. Bennett, Carl L. Bannister, and William D. Bennett. The certificates were presented by Edward P. Lupfer, Acting President of the Society, who paid tribute to the recipients of these awards.

CENTRAL OHIO SECTION

Members of the Central Ohio Section met at the Chittenden Hotel on November 18 for their monthly luncheon. There were

present on this occasion to hear the guest speaker, P. W. Maetzel, chief engineer of the city of Columbus. Mr. Maetzel discussed the topic, "Interesting Facts Concerning the Use of Cast Iron Pavement."

Cleveland Section

More than 100 members and guests of the Cleveland Section were present at a luncheon meeting that took place in the Chamber of Commerce Club on December 7. The feature of the occasion was a talk by H. B. Carpenter, manager of the Corrigan District of the Republic Steel Corporation, who discussed the subject, "The World's Largest Continuous Strip Mill." Mr. Carpenter pointed out the major engineering accomplishments in the construction of this mill, and following his talk members of the Section made an inspection trip through the mill.

Detroit Section

A joint dinner meeting of the Detroit Section and the University of Michigan Student Chapter was held at the Michigan Union in Ann Arbor on November 19, the occasion being the initiation of new members into the Student Chapter. Prof. John S. Worley proved an able toastmaster, while R. S. Frazier, president of the Student Chapter, extended greetings. Other members of the Chapter also spoke briefly. A talk was then given by Henry E. Riggs, honorary professor of civil engineering at the University of Michigan. The concluding address of the evening was presented by Harry C. Anderson, newly appointed head of the engineering college at the University of Michigan, who discussed his experiences in over thirty years of teaching. There were 70 present, about half of this number being students.

Indiana Section

Following its usual custom, the Indiana Section combined its fall meeting with an inspection trip. The two-day trip, which took place on October 22 and 23, included visits to the Gary plant of the American Bridge Company, the mills of the Carnegie-Illinois Steel Company in Chicago, and the Southwest Works of the Chicago Sanitary District. The accompanying photograph shows a view of the group at the latter plant. On the evening of the 22d, members of the group were guests at a banquet given by the Portland Cement Association in Chicago. There were talks on this occasion by

Indiana Section and Student Chapter Guests at Southwest Works, Chicago Sanitary District

J. R. Van Pelt, assistant director of the Museum of Science and Industry; Frank T. Sheets, president of the Portland Cement Association, and Langdon Pearse, chief engineer of the Chicago Sanitary District. Charles A. Ellis, president of the Indiana Section, acted as toastmaster. One of the highlights of the occasion was a boat trip on the Chicago River and its south branch, which gave the members an opportunity to inspect a number of movable bridges. About 100 members and guests participated in the two-day meeting, about 60 of these being senior-class civil engineering students from Purdue University, Rose Polytechnic Institute, and Notre Dame, who were guests of the Section.

Iowa Section

The nineteenth annual meeting of the Iowa Section was held at Iowa State College Student Chapter in Ames on the afternoon and evening of November 18. The attendance at the afternoon session was 70, while 100 were present at the dinner and evening meeting. The afternoon business session included the annual election of officers, the results being as follows: R. E. Robertson, president; A. H. Wieters, vice-president; and R. B. Kittredge, secretary-treasurer. This was followed by talks by A. J. Boase, manager of the Structural Bureau of the Portland Cement Association; Garlin A. Robinson, member of the State University of Iowa Student Chapter; and David H. Currie, member of the Iowa State College Student Chapter. The after-dinner speakers were Frank J. McDevitt, Director of Streets and Sewers, St. Louis, who spoke on "Highlights of Traffic Safety Work in the City of St. Louis"; and the Honorable Harry H. Porter, chief justice of the Municipal Court, Evanston, Ill., whose topic was the "Court's Responsibility in Accident Prevention."

Kansas City (Mo.) Section

As usual, the Kansas City (Mo.) Section participated in the annual joint meeting of the Engineers Club, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and the American Society of Heating and Ventilating Engineers. This event, which occurred on December 1, was sponsored by the Engineers Club. The speaker of the evening was E. F. Weber, superintendent of automotive equipment for the Burlington Railway Lines, whose subject was "Modern High-Speed Railway Transportation and the Use of Diesel Engines as Motive Power." There were 400 present.

Los Angeles Section

About 150 members and guests of the Los Angeles Section met at the Friday Morning Club on November 10 to hear a program featuring two noted scientists. Dr. Max Mason, formerly president of the Rockefeller Foundation and now chairman of the board erecting the 200-in. telescope on Mt. Palomar, spoke on the philanthropies of the Foundation and emphasized its efforts to increase world health. Then D. O. Knudsen, of the University of California, who is an outstanding student of acoustical problems, discussed the design of auditoriums to give the maximum reception.

Prior to the regular meeting, the Junior Forum of the Section met to hear W. J. Simon and Sterling S. Green speak on compaction and other problems involved in earth-fill construction. About 20 Juniors attended this session.

Metropolitan Section

At a meeting of the Metropolitan Section held on December 15 the Section had as its guests the members of the eight Student Chapters in the Metropolitan area. More than half of the 450 persons in attendance were students. An illustrated lecture on "The Weather Bureau's Contribution to the Solution of Hydrologic Problems" was given by Dr. Willis R. Gregg, chief of the Weather Bureau, U. S. Department of Agriculture. Antonio Romero, secretary of the Puerto Rico Section, who was in New York on business, was welcomed and introduced by President Hudson. The meeting on November 17 had as its general subject new developments in alloy structural steels. H. H. Moss, development engineer for the Linde Air Products Company, presented an illustrated paper on "New Developments in the Flame Cutting of High Tensile Structural Steel," and C. F. Goodrich, chief engineer of the American Bridge Company, presented a talk and motion picture on the San Francisco–Oakland Bay Bridge. About 500 were in attendance.

The feature of the November 23d meeting of the Junior Branch of the Metropolitan Section was an illustrated talk by Robert Ridgway, Past-President of the Society, on the subject of New York's subways. On December 7 the Junior Branch held its mid-season dinner meeting, at which Enoch R. Needles, Director of the Society, spoke on "This Business of Engineering."

Mid-South Section

A report from the Mid-South Section indicates that its semi-annual meeting, held in Greenville, Miss., on November 5 and 6, was one of the most successful in the existence of the Section. At luncheon on the first day an address of welcome was given by Mayor Milton C. Smith, and Walter F. Schulz, president of the Section, responded for the Section. The program of the technical session held during the afternoon included talks by E. E. Howard, consulting engineer of Kansas City; R. A. Harris, chief engineer of the State Highway Commission; and George W. Vinzant, county engineer of Washington County, Mississippi. Following dinner in the evening, certificates of life membership were presented to Edwin C. Finley, James E. Garrett, W. M. Gerig, Ira G. Hedrick,

Don A. Maccrea, Gerard H. Matthes, Harry N. Pharr, and Thomas H. Tutwiler. Two inspection trips proved of interest on the second day of the session—one a boat trip through Greenville Harbor and cutoff, the other a trip over the Washington County road system.

Milwaukee Section

A joint meeting of the Milwaukee Section and the Marquette University Student Chapter took place at the City Club on November 18. Preceding the technical session, there was a business meeting at which numerous matters were discussed. The feature of the evening was a talk on the subject, "Contribution of Science to Lighthouse Engineering," which was given by Guy B. Skinner, superintendent of lighthouses at Milwaukee for the 12th Lighthouse District. Mr. Skinner illustrated his remarks with an exhibit showing some of the devices used by the lighthouse department to regulate navigation. An interesting general discussion followed his talk.

Nashville Section

One of the features of the November meeting of the Nashville Section, which was held in Kissam Hall at Vanderbilt University on the 2d, was the presentation of a certificate of life membership to A. J. Dyer. The guest of honor on this occasion was L. F. Bellinger, Vice-President of the Society, who discussed various activities of the Society. At the conclusion of Mr. Bellinger's remarks, the members of the Section joined the Vanderbilt University Student Chapter in Science Hall, where Mr. Bellinger gave a talk on the civil engineer in connection with the U. S. Navy. This talk was illustrated with slides of various construction activities. There were 15 present at the meeting proper, which was preceded by a dinner in Kissam Hall.

New Mexico Section

On October 9 a joint meeting of the New Mexico Section and the New Mexico State College Student Chapter took place at Las Cruces, N.Mex. The technical program arranged for the occasion consisted to talks by S. F. Crecelius, chief engineer of Caballo Dam, who discussed the dam; L. M. Lawson, American commissioner for the International Boundary Commission, whose topic was the rectification and canalization of the Rio Grande; and J. Ledbetter, Jr., designing engineer of the International Boundary Commission, who discussed the design of the American Diversion Canaland Dam. An informal discussion followed.

Northeastern Section

Following a dinner at the Harvard Faculty Club, a joint meeting of the Northeastern Section of the Society and the Boston Society of Civil Engineers took place at Pierce Hall in Cambridge on November 3. There were 26 at the dinner, and 40 at the meeting. After a brief business session the speaker of the evening, William F. Wells, was introduced. Mr. Wells, who is on the staff of the University of Pennsylvania, spoke on the topic, "Light on Air-Borne Infection—a New Problem for the Engineer."

Northwestern Section

There were 36 present at a joint dinner meeting of the Northwestern Section of the Society and the local branch of the Society for the Promotion of Engineering Education, which took place at the Minnesota Union in Minneapolis on November 11. A report of the National Resources Committee on the drainage basins in the area was read, and various business matters were discussed. Then the guest of honor, Otis E. Hovey, was introduced. Mr. Hovey, who is treasurer of the Society and director of the Engineering Foundation, gave an interesting talk on the activities of the Foundation.

Philadelphia Section

On November 17 members of the Philadelphia Section enjoyed a meeting of unusual interest. The subject of the technical program was asbestos-cement pipe as a carrier of water, which is of comparatively recent use in this country. The speaker was Herbert Ickler, district engineer for the Johns-Manville Company, who outlined the development of the use of this pipe and then presented a film which showed in detail every step in the manufacture and installation of transite pressure pipe, the asbestos-cement pipe made in the factories of the Johns-Manville Company. The interest of the members in the subject of asbestos-cement pipe for water transportation was shown by the many questions asked at the conclusion of the talk and motion picture. There were 34 present at the dinner, and 85 at the meeting following it.

Pittsburgh Section

On November 8 a meeting of the Pittsburgh Section was called to order in the William Penn Hotel. Talks were given by Webster N. Jones, director of the college of engineering at Carnegie Institute of Technology, and R. P. Davis, Director of the Society. A special feature of the occasion was the presentation of certificates of life membership to G. L. Christy, V. R. Covell, R. A. Cummings, C. S. Davis, G. S. Davison, T. A. Gilkey, F. A. Hastings, W. C. Hawley, G. H. Hutchinson, R. Khuen, Jr., G. M. Lehman, E. K. Morse, L. J. Riegler, S. A. Taylor, G. C. Urquhart, W. M. Venable, and T. J. Wilkerson. On December 3 a joint meeting of the Section and the Engineers Society of Western Pennsylvania was addressed by Samuel W. Marshall, chief engineer of the Pennsylvania Department of Highways. The subject of Mr. Marshall's talk was the proposed superhighway from Pittsburgh to Harrisburg.

Portland (Ore.) Section

An unusually large number of speakers was heard at a meeting of the Portland (Ore.) Section held on November 29. Those listed on the technical program were Thomas M. Robins, division engineer in the U. S. Engineer Office; C. I. Grimm, head engineer in the U. S. Engineer Office at Portland; George E. Goodwin, senior engineer in the U. S. Engineer Department at Portland; R. E. Koon, consulting engineer of Portland; and H. B. Holmes, biologist for the U. S. Engineer Office. A brief discussion from the floor followed these talks. There were approximately 165 present.

Providence Section

The Providence Section held a meeting in the Engineering Society Building on October 20, with 23 present. On this occasion a talk was given by B. J. Fletcher, an engineer in the development division of the Aluminum Company of America. This talk, which covered recent developments in the design of aluminum alloy structures, was illustrated with lantern slides. At a meeting of the Section, which took place on November 10, S. Frank Nolan, city engineer of Providence, discussed local traffic problems and some of the solutions that have been proposed. The attendance numbered 53.

Sacramento Section

In accordance with its usual custom, the Sacramento Section held weekly luncheon meetings during the month of November. There were 41 present on November 2 to hear a talk on the water problems of the Rio Grande given by Harlowe M. Stafford, supervising hydraulic engineer for the State Division of Water Resources. "Along the Soil Erosion Front in California" was the subject of an illustrated lecture given by Harry E. Reddick, regional conservator for the U. S. Soil Conservation Service on November 9. There were 46 present. The attendance at the November 16th meeting numbered 67. On this occasion the speaker was Ralph W. Cheney, professor of paleontology at the University of California. A paper on "Highway Rental, a New Conception of Return for Use," was presented at the November 30th meeting by C. S. Pope, construction engineer for the California State Division of Highways. There were 58 present. A special evening meeting took place on November 23 for the purpose of presenting certificates of life membership. Those thus honored were Jeremiah Ahern, Joseph C. Boyd, R. B. Marshall, and Emery Oliver. A talk by Frederick W. Panhorst, state highway bridge engineer, was also given. The attendance was 112.

St. Louis Section

Following an established custom, the St. Louis Section was host to Student Chapter members of the engineering schools in Missouri (the University of Missouri, the Rolla School of Mines, and Washington University) at its annual dinner meeting. The feature of the evening was a talk by Thad Snow, speaker and writer, who gave a humorous talk that showed a sound background of economics and philosophy and should prove of vocational value. During the annual business session the following officers were chosen for the ensuing year: W. C. E. Becker, president; J. T. Garrett and H. F. Thomson, vice-presidents; R. A. Willis, secretary-treasurer; and J. H. Porter and H. E. Frech, councilors. There were 96 present.

Syracuse Section

At a special dinner meeting, held at the Onondaga Hotel on November 23, the Syracuse Section entertained seven life members

of the Society to whom certificates were given. These were as follows: J. P. Brooks, E. B. Baker, T. E. Knowlton, J. W. Beardsley, D. R. Lee, G. D. Holmes, and N. E. Whitford. The accompanying photograph shows Louis Mitchell, dean of the college of applied science at Syracuse University, making the presentations. John P. Brooks, president emeritus of Clarkson College of Tech-

SEVEN MEMBERS OF SYRACUSE SECTION RECEIVE CERTIFICATES OF LIFE MEMBERSHIP

nology, responded for the recipients. The guest speaker was Chancellor William P. Graham, of Syracuse University. Others who spoke were Field Secretary Jessup and Earl F. O'Brien, president of the Syracuse Section. There were about 40 present.

Tacoma Section

At a meeting of the Tacoma Section held on September 11, the speakers were C. M. Howard, who reported on a meeting of the Structural Division of the Seattle Section, and an engineer from the Tacoma Smelter. This was followed by an inspection trip through the smelter. Several business matters were discussed at the meeting held on October 11, and a nominating committee was appointed. The speaker of the evening was R. G. Tyler, head of the department of civil engineering at the University of Washington. At the meeting held on November 8 the report of the nominating committee for 1938 officers was accepted, the list being as follows: E. L. Warner, president; R. C. Knapp, vice-president; and W. H. Ashley, secretary-treasurer. The speaker was C. E. Magnusson, of the University of Washington.

Tennessee Valley Section

The fall meeting of the Tennessee Valley Section took place in Asheville, N.C., on October 21 and 22, with 125 members and guests registered for the two-day session. The speakers heard at the first morning session were R. Getty Browning, of the North Carolina State Highway Department; T. S. Johnson, chief engineer of the North Carolina State Department of Conservation and Development; and S. T. Henry, Southern representative of the *Engineering News-Record*. In the afternoon a sight-seeing trip through the Vanderbilt house and estate at Biltmore, N.C., was enjoyed. In the evening there was a banquet at the Grove Park Inn, the speakers being Arthur E. Morgan, chairman of the Tennessee Valley Authority, and Everitt W. Wilson, manager of R. W. Hebard and Company in Lisbon, Portugal, who discussed the civil war in Spain. On the second day the list of speakers included R. E. B. Sharp, hydraulic engineer of the Baldwin-Southwark Corporation; C. R. Hursh, forest ecologist of the Appalachian Forest Experiment Station; and Ross Riegel and K. C. Roberts, of the Tennessee Valley Authority. The concluding papers dealt with the unionization of engineers. The first was presented by George T. Seabury, Secretary of the Society, and the other was prepared by F. E. Schmitt, editor of the *Engineering News-Record* and presented by Mr. Henry. At the conclusion of this session, there was a brief business meeting, at which the following officers were elected: H. L. Fruend, president; and C. W. Okey, Lee G. Warren, A. L. Pauls, and E. D. Burchard, vice-presidents. Hal H. Hale was reelected secretary-treasurer.

Toledo Section

There were 21 present at a meeting of the Toledo Section, which was held at the Elks Club on November 30. After dinner and a short business session others came in to hear a lecture given by Frank E. McLeary, head of the U. S. Weather Bureau in Toledo. In his talk, which was on the subject of "Weather Bureau Operation," Mr. McLeary explained the function of the various instruments used for weather determination and prediction.

Student Chapter Notes

Lafayette College

On November 4 the Lafayette College Student Chapter sponsored the showing of the Society's illustrated lecture on the George Washington Bridge, which was given by Nils Askman, a member of the Student Chapter. There were approximately 25 present. An audience of 22 attended a meeting held on November 11, at which W. W. Harker delivered the Society's illustrated lecture on the Holland Tunnel.

Oregon State Agricultural College

At the beginning of the school year the Oregon State College Student Chapter conducted an intensive membership drive that resulted in virtually complete enrolment of those eligible for membership. The Chapter took an active part in the annual "Engineers' Bust" and won the gold trophy presented each year for the best skit or act presented by student members of any of the Founder Societies. Nearly 100 students and faculty members attended the fall-term breakfast, which was held on November 14. The guest speaker on this occasion was C. B. McCullough, assistant state highway engineer for the Oregon State Highway Department, who recently returned from Central America where he spent two years designing, locating, and constructing six bridges. Members of the Chapter also made visits to Bonneville Dam in order to inspect the great turbines before the water is turned into them. These trips were made in a truck which was recently purchased by the civil engineering department.

Rutgers University

There were about 15 present at a meeting of the Rutgers University Student Chapter held on November 1. The feature of the occasion was the presentation of the Society's illustrated lecture on aerial photographic mapping. The lecture aroused considerable enthusiasm, and an interesting discussion followed.

Tufts College

The regular monthly meeting of the Tufts College Student Chapter was held on October 28, with 18 present. On this occasion the Society's illustrated lecture on aerial photographic mapping was presented by Lloyd B. Oppenheim, a senior-class member of the Chapter. The interest aroused by this lecture was evidenced by the enthusiastic discussion following it.

University of Colorado

The University of Colorado Student Chapter has again made a program for its year's activities. Printed copies of its 1937–1938 program of events, received at Society Headquarters, indicate that students will present a number of papers at the Chapter's technical sessions and that these papers will cover a wide range of timely engineering topics. This procedure is in line with suggestions made by Hunter W. Hanly, M. Am. Soc. C.E., in his article entitled "Helpful Hints to Student Chapters" in the November issue of Civil Engineering.

University of Illinois

On November 23 the Society's lantern slide lecture on the Carquinez Strait Bridge was shown before a meeting of the University of Illinois Student Chapter. The commentary on the lecture was given by T. C. Shedd, professor of structural engineering at the university. There were 70 students present and 12 members of the faculty.

University of Maine

The University of Maine Student Chapter held its second meeting of the present school year on October 21. After a brief business session the members of the Chapter enjoyed the Society's lantern lecture on the George Washington Bridge, which was presented by Carleton Doak, Jr. Following this, a reel of motion pictures depicting life at the University of Maine civil engineering summer camp was shown. There were 24 present.

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for February

Among the articles scheduled for the February issue is one by Gene Abson, chemical engineer, Chicago Testing Laboratory, Inc., on the manufacture of asphalt. Although one of the world's oldest materials of construction, asphalt has attained widespread recognition only within comparatively recent years, following the discovery that the volatile components of certain crude petroleums can be removed by distillation, leaving asphalt residues. This operation is usually performed by continuous distillation, employing tube or pipe stills for heating the crude oil, and drums connected to fractionating towers into which the various components are vaporized. Oxidation, the only other common method of asphalt manufacture, involves bringing hot residuum into contact with air, effecting a chemical transformation. The article concludes with some information of considerable value to the specification writer—a discussion of the proper characteristics of asphaltic products for use in paving and in roofing work.

Soil losses from water and wind erosion, as well as resultant silting of reservoirs, are largely preventable, says H. O. Hill, Assoc. M. Am. Soc. C.E., project leader of soil conservation investigations at Blackland Experiment Station, Temple, Tex., in describing the successful work of the U. S. Soil Conservation Service on the Elm Creek watershed of central Texas. Among the methods of control found most effective on that project are terracing; strip cropping, both with and without terracing; pasture furrowing or ridging; and gully control by means of erosion check dams and vegetation. Many of the methods developed in the Texas blacklands are equally applicable to undulating or rolling areas in other parts of the country.

In an article on the esthetics of bridge design, Aymar Embury II, M. Am. Soc. C.E., consulting architect, New York, N.Y., discusses from an architectural viewpoint the design of anchorages for suspension spans, using as illustrations two large bridges now in place in New York and a third in process of construction. In the case of the Triborough Bridge, the function of the anchorages as counterpoises to the weight of the span was emphasized by their shape and surface treatment. The anchorages for the Whitestone Bridge will approximately take the form of the cables as they bend around the rocker arms and enter the concrete, with forward sides nearly perpendicular to the slope of the cables. The George Washington Bridge offers an entirely different problem because of the absence of sloping approach viaducts. The original design, only partially executed, contemplated a traditional treatment suggestive of a granite building exterior. Two alternate designs have been proposed, one embodying a "promontory" conception, and the other (based primarily upon function) utilizing a spiral-like curve on the river sides of the buttresses and exposing the cable spreads on the approach sides.

If space permits there will be included an article on utility planning for Greendale, Wis. (a model town constructed by the Resettlement Administration), by Walter E. Kroening and Frank L. Dieter, assistant principal and civil engineer, respectively, for the Greendale Project, U. S. Department of Agriculture, Division of Suburban Resettlement. The project, which will initially provide housing and community facilities for 572 families of modest income, also includes a publicly owned and operated water works, sewerage works, and electrical distribution system. Rarely if ever have engineers had an opportunity to plan the layout of a town and its utility services concurrently, while the site is still an open pasture, and the project is of interest as an illustration of what can be accomplished under such favorable conditions.

Wise and Otherwise

In Professor Abercrombie's hydraulic laboratory at the University of Calisota, a block of ice weighing 50 lb is floating 1 ft from the left end of a rectangular-shaped trough 2 ft wide, 1 ft deep, and 10 ft long. The surface of the water is exactly at the top of the trough, which is supported at the ends. Professor Abercrombie gives the block just sufficient impetus to cause it to move slowly to a point 1 ft from the right end, without having the ripples overflow. There it melts. When the ice is in the first position, what part of its weight is carried by the left reaction? What part when the block arrives at the second position? What happens to the water in the trough when the ice melts? This problem appeared originally in *The News*, a publication of the Philadelphia Section of the Society.

December's problem involved a squirrel inside a hollow tree, traveling between two holes 75 ft apart. It takes him one minute to make the first trip to the upper hole, and thereafter he halves his time each trip as he shuttles back and forth. A dog standing near the tree is the cause of this display of nerves. The problem asks how long it will take for the dog to see the squirrel's head at both knot-holes at the same time.

Assuming for the purpose of the problem that the squirrel is capable of the necessary agility, an infinite speed and an indeterminate distance would be involved before the squirrel's head *actually* protruded from both holes at the same time. But if his head appeared at each hole 40 times or more per sec, physicists say that it would *seem* to the dog to be protruding from both simultaneously. On the twelfth trip, the squirrel will cover the distance in 0.0293 sec, and on the thirteenth trip, 0.0147 sec. The phenomenon will therefore begin at the lower hole at the end of the fourteenth trip, which will require 0.0073 sec. The total time elapsing will be almost (but not quite) two minutes.

In the problem concerning Professor Abercrombie's motor trip in Deliria, which appeared in the November 1937 issue and was synopsized and solved in December, it was inadvertently stated that the cars slowed down again to 20 mph after leaving the town, whereas the solution as given by the author, Mr. Trillow, was based on a rate of 40 mph both within the town and inland from it. Had both cars reduced speed to their original rates on emerging from the town, the distance intervening obviously would also have diminished to its original amount of 100 ft.

Suggestions for other problems for Professor Abercrombie's column, accompanied by solutions, may be addressed to the editor. Solutions should preferably be sent in separate enclosed envelopes.

Plans Under Way for Fifth International Congress for Applied Mechanics

Announcement has recently been made of a Fifth International Congress for Applied Mechanics, to be held in the lecture rooms of the Massachusetts Institute of Technology on September 11–17, 1938, inclusive, under the sponsorship of the Institute and of Harvard University. Technical sessions will be held in the following fields of applied mechanics:

(a) Structures, elasticity, plasticity, fatigue, strength theory, and crystal structure

(b) Hydro- and aerodynamics, gasdynamics, hydraulics, meteorology, water waves, and heat transfer

(c) Dynamics of solids, vibration and sound, friction and lubrication, and wear and seizure

Copies of a circular outlining the principal features of the program have been sent to members of the Fourth Congress. Those readers who expect to attend the Fifth Congress should provide their addresses, together with the field of applied mechanics in which a communication is contemplated, in order that they may be sent further notices. Addresses should be sent to J. C. Hunsaker, secretary of the Congress, at the Massachusetts Institute of Technology, Cambridge, Mass.

Developments in Federal, State, and Regional Planning

Planning "from the ground up" is progressing at all levels of government, according to the progress report of the National Resources Committee made public November 10, 1937. Reviewing its advisory efforts to stimulate local and state planning and to encourage decentralization of planning activities, the committee points out that, in addition to the 46 state planning boards, there are now approximately 400 county planning agencies and more than 1,700 similar groups in towns and cities.

The committee predicts that state planning boards will increase their resources and usefulness, not only through closer cooperation with other state agencies, private groups, and federal bureaus, but because many state legislatures have increased planning appropriations. Organization of the numerous county planning boards is described by the committee as "an encouraging sign of the awareness of the rural population to planning problems."

In addition to the Progress Report, three other recent publications on planning should be mentioned here. "Regional Planning—Part IV" deals with the Baltimore–Washington–Annapolis area. It makes recommendations for regulating the form and character of growth of suburban areas, acquisition of lands for forests and parts, construction of major parkways, and so forth, and suggests the establishment of a coordinating committee, sponsored by the Maryland State Planning Commission, to prepare a ten-year fiscal program indicating priorities for various projects and the proportion of funds to be furnished by local, state, and federal agencies. This report is issued by the Maryland State Planning Commission, but is designed to form part of the series on regional planning in which the National Resources Committee has been interested. It is for sale by the Commission (Latrobe Hall, Johns Hopkins University, Baltimore) at 40 cents a copy.

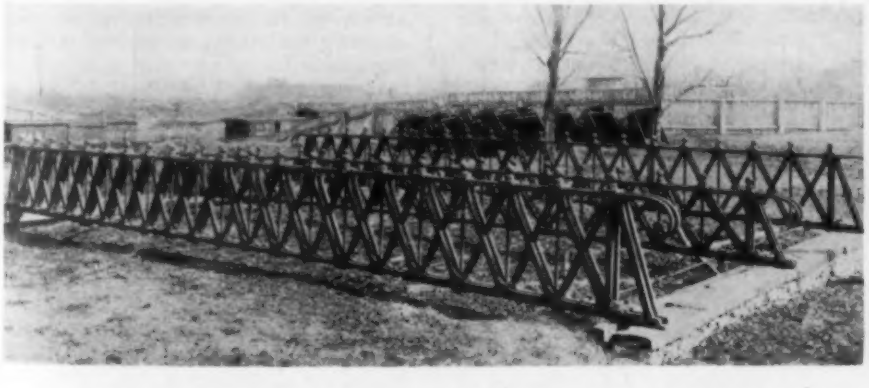
"Regional Planning—Part V" details a plan for the valley of the Red River of the North. The chief features of the plan, which include water conservation, water works, sanitation, and flood-flow correction, were outlined by W. W. Horner, M. Am. Soc. C.E., in an article in Civil Engineering for March 1937. The report, published by the National Resources Committee, is for sale by the Superintendent of Documents, Washington, D.C., at 25 cents a copy.

"Our Cities—Their Rôle in the National Economy," is the title of an 88-page report released late in September 1937 by the National Resources Committee. Major recommendations of the report, in part, are: That the federal government should continue its policy of assistance to the social-welfare programs of urban communities; that a section for urban research be set up in some federal agency which would perform for urban communities functions comparable to those now performed for rural communities by the Department of Agriculture; and that Congress should pass legislation laying down the conditions for interstate compacts enabling adjoining communities in separate states to deal jointly with health, sanitation, and so forth. Copies of the report are available at 50 cents each from the Superintendent of Documents.

First Iron Railroad Bridge in America

The first iron railroad bridge in America (and, incidentally, one of the first in the world) is shown in the accompanying picture. It was erected in 1845 over a small stream and public road crossing on the main line of the Philadelphia and Reading Railroad, near West Manayunk, Pa. The designer was Richard B. Osborne, then chief engineer of the company.

The superstructure consisted of three Howe trusses, with a span of 34.2 ft, carrying the ties on their bottom chords. As the tracks were only 4 ft apart, the center truss was held to a height of $31\frac{1}{2}$ in. in order to be below the platform steps of passenger cars. The outer trusses were $41\frac{3}{4}$ in. in height.



Trusses of First Iron Railroad Bridge Built in This Country

This Bridge Saw 56 Years of Service. The Trusses Are Now at the Reading, Pa., Shops of the Reading Company

The chords were rolled iron and the braces of cast-iron. The latter members rested on cast-iron blocks, attached to the chords by hand-forged lugs. A peculiarity of the construction was the use of extra-heavy canvas washers, of which a single thickness, soaked in white lead, was placed between the end of each brace and the lug. These washers 59 years later were found to be sound and apparently as good as when put in place.

When it is considered that all the work was done by hand, by the company's own men, with only such meager facilities as were afforded by a blacksmith's forge and hand tools, the attention given to details is remarkable. For example, it will be noted in the photograph that the braces were fluted on the sides.

Construction of the trusses was begun in the company's shops at Pottstown, under Mr. Osborne's supervision, in January 1845, and was finished in March. The work of erection was commenced on Saturday night, May 3, and the bridge was finished, ready for the passage of trains, on Sunday, May 4. The president of the road, John Tucker, went up to see the first trains go across. He was pleased with the bridge, but said it looked very light in comparison with timber structures and suggested that the falsework be left in, up to within $\frac{1}{2}$ in. of the bottom chords, until it had been given a longer test. This was done to satisfy President Tucker, and the timber remained until it fell down.

The bridge remained in place until 1901, although for some years before that it had been supported by heavy timber trestles. In its period of usefulness of 56 years, it carried, without doubt, the greatest aggregate tonnage that ever passed over a railroad bridge up to that time.

The first iron bridge was followed in the summer of 1845 by three others, quite similar to it except that the top and bottom chords were built up of flat iron. These structures were over Stony Creek, near Port Clinton; Irish Creek, near Leesport; and Bingaman Street, in the City of Reading.

Mr. Osborne, their designer and builder, was born and educated in England. He started with the Philadelphia and Reading Railroad Company as draftsman under Chief Engineer Moncure Robinson in 1838, built a large part of the original main line and many of its branches, and was appointed chief engineer in August 1842. Between 1853 and 1857 he located and built the Lebanon Valley Railroad. On this line he used masonry arches to a large extent, and one of these bridges, the skew arch over Sixth Street in Reading, is of special historical interest.

This article was prepared by Clark Dillenbeck, M. Am. Soc. C.E., chief engineer of the Reading Company, in cooperation with I. L. Gordon, publicity director of the Reading Company, Philadelphia, Pa. It was secured by John Gibb Smith, Jr., junior correspondent for Civil Engineering (Philadelphia Section).

"See Here, Thou Stupid Villian, See Here"

THE EXTREME delicacy with which professional disagreements were sometimes aired in the eighteenth century is exemplified in the accompanying page from a tract published in 1748. Richard S. Kirby, M. Am. Soc. C.E., who contributed the picture, supplies the following details:

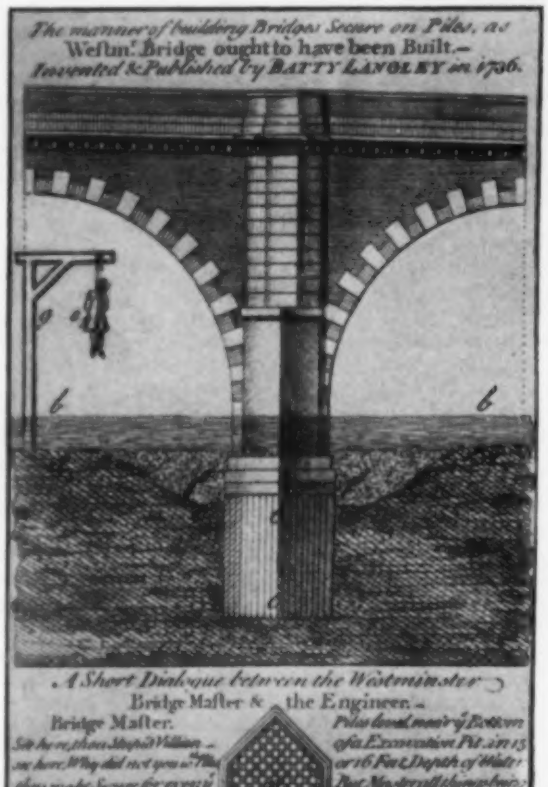
"The view shows the first Westminster Bridge, spanning the Thames at London close to the Abbey, and under construction in 1748. The engineer, pendant on paper only, was the clever Charles Paul Dangeau Labelye, born and bred, as he said, in 'Swisserland.' He had come to England as a young man and started planning this bridge about ten years before the date of the picture. Instead of building 'upon stilts,' he used open caissons for some of the piers, then something of a novelty.

"Before the bridge was finished, a pier settled three feet or so and had to be rebuilt at considerable expense. Thereupon Batty Langley, a disappointed aspirant for the position of engineer, seized the occasion to give vent to his feelings of jealousy against the foreign-born engineer, and issued the broadside from which this page is taken. Langley, it should be remarked, was Labelye's senior by some years, a man apparently of higher professional standing, and the author of a great number of works on architecture."

The title page of Langley's pamphlet predicted a doubtful future for the bridge.

"In spite of Batty Langley," continues Mr. Kirby, "Labelye's masterpiece was satisfactorily completed, although at a cost, it is said, triple that originally provided by a lottery. The bridge served Londoners more than a century, until Labelye died in obscurity and want, probably in Paris.

"There was no engineering society in the world in 1748. Perhaps John Smeaton, just beginning his life work at the time, may have seen a copy of this pamphlet. If so, the folly of it all may have influenced him later to organize the Smeatonian Society, the first volunteer engineers' club in the world."



THE DELICATE ART OF PROFESSIONAL CRITICISM, 1748

A

SURVEY

OF

Westminster BRIDGE,

As 'tis now

SINKING into RUIN.

WHEREIN

The CAUSE of the FOUNDATION giving way under the Sinking Pier, and its dislocated Arches, is not only accounted for;

BUT ALSO,

That the whole Structure is likewise subject to the same immediate (if not unavoidable) Ruin.

With REMARKS

On the PIRATICAL METHOD used for Building the Piers.

AND

A JUST ESTIMATE of the Expence for which all their Foundations might have been made secure with PILES, until every Stone, with which the Bridge is built, was *torn* into *Atoms*, by the hungry Teeth of devouring TIME.

By BATTY LANGLEY, *of Meard's Court, Dean-Street, Soho,* ARCHITECT.

LONDON:

Printed for M. COOPER, at the *Globe* in *Paternoster Row.* 1748. [Price 1 s.]

Brief Notes from Here and There

THE Swiss Society of Engineers and Architects (Schweizerischer Ingenieur-und Architekten-Verein) celebrated its hundredth anniversary in Berne, Switzerland, September 6 and 7, 1937. Karl E. Hilgard M. Am. Soc. C.E., a resident of Zurich, was the official representative of the American Society of Civil Engineers on this occasion. Professor Hilgard reports an attendance of more than a thousand members of the Swiss Society, and about 70 delegates of other Swiss and foreign organizations. A feature of the program was a speech by a representative of the Swiss Government, "thanking the society for its fruitful activities." A 200-page memorial volume was issued in connection with the celebration, and a copy is on file in the Engineering Societies Library, 29 West 39th Street, New York, N.Y. It is of special interest for its informative articles (in German and French) tracing the development of architecture and of civil, electrical, mechanical, and "geodetic" engineering in Switzerland since 1837.

* * * *

NORTH Carolina State College is sponsoring a number of events of interest to engineers in the week beginning January 24, 1938. An "Institute for Surveyors" is scheduled for January 24–26; it will be conducted as a school, and is designed to help surveyors "keep up-to-date" and make them more proficient. On January 27, the School of Engineering, in cooperation with the North Carolina Society of Engineers, is holding an "Institute for Engineers." This will be followed by the annual winter convention of the state society, which extends through Saturday, January 29. The last day's program will include technical sessions of the state sections of various engineering societies, including the American Society of Civil Engineers.

* * * *

A RADIO dramatization of the life of James Buchanan Eads (1820–1887), pioneer American bridge builder, will be broadcast over the national network of the Columbia Broadcasting System on January 5, 1938, from 8:00 to 8:30 p.m., Eastern Standard Time, according to a recent announcement. A rebroadcast will be made for West Coast stations at 12:00 midnight, Eastern Standard Time. In this program of the "Cavalcade of America," sponsored by the Du Pont Company of Delaware, tribute will be paid to the Indiana boy who completed the world's first steel-arch bridge over the Mississippi River at St. Louis in 1874.

Schoklitsch's "Wasserbau" in English

Reviewed by I. Gutmann
Editor, Engineering Index, Inc., New York, N.Y.

It will be welcome news to English-reading hydraulic engineers the world over, that Professor Schoklitsch's monumental *Wasserbau* has been translated into English at the expense of the John R. Freeman Trust Estate, and published by the American Society of Mechanical Engineers. (*Hydraulic Structures*, by Armin Schoklitsch; translated by Samuel Shulits, Assoc. M. Am. Soc. C.E. Translation reviewed by Lorenz G. Straub. 1172 pp. (2 Vol.). Published by American Society of Mechanical Engineers, 1937. $18, less 20 per cent discount to members of A.S.M.E. and Am. Soc. C.E.)

Comprehensive one-author two-volume works covering all branches of hydraulic engineering have been a tradition of long standing in Germanic engineering literature. In the second half of the nineteenth century they had Max Becker's and Gotthilf Hagen's texts; the period of 1914–1923 saw three successive editions of Hubert Engels' *Handbuch des Wasserbaues;* and in 1930 Professor Schoklitsch published the treatise whose English translation we now welcome.

Engineering literature in the English language has no equivalent of this treatise. *The Control of Water* compiled by Philip à Morley Parker, some twenty-five years ago, parallels it to a degree but is not as wide in scope. For in addition to hydrology, general hydraulics, dams, materials of construction, hydraulic machinery, water supply and irrigation works treated of in Parker's manual, Professor Schoklitsch's work also covers soil mechanics, sewers and sewage disposal, hydroelectric power plants, river improvement and flood control, and inland waterways including canal locks and ship lifts.

As wide as the scope of this work appears from this mere enumeration of the main subjects treated, it is rather narrow in another respect—it is decidedly not cosmopolitan. It summarizes, with some exceptions of course, only the theory and practice developed in Germany and Austria and their former possessions, and in Switzerland. Practically all the equipment and nearly all the plants and structures described are German and Austrian. This observation is not made in the spirit of criticism, since the book is primarily a text for Germanic students of engineering. Moreover, engineers, American as well as German, have always been unduly inclined to unprofitable national autarchy in their profession, immeasurably more so than chemists, physicists, and psychiatrists.

It should also be remembered that after all the function of the English version of the work is not to supplant American or British texts, but to serve as supplementary study material for advanced students and practicing engineers. As such it is a highly stimulating and authoritative work by an eminent engineer and a famous teacher of engineering, replete with interesting ideas and experiences, "different" points of view and methods of attack which are bound to exercise a broadening effect on the individual reader and in the long run to have a profound influence on American hydraulic practice. Being the first foreign work of its kind to be given wide circulation among English-reading engineers, it is destined to make engineering history.

It is to be regretted that the publication of the English version was not seized upon as an opportunity for bringing the work up to date by revising and supplementing. It is a truism that with the present tempo of progress and research, an engineering book is bound to become more or less out of date during the period intervening between its compilation and release for sale. Professor Schoklitsch's treatise was completed in 1929—eight years before its English translation went to press. Now, a great deal happened in hydraulic engineering during this period, and the author should have been urged to enhance the value of his book by bringing it up to date. Take the division on sewerage as an illustration. Had it been revised as suggested, it surely would have contained information on the recovery and utilization of gas from sewage disposal, and no doubt the section, "Chemical Methods," would have exceeded the nine lines opening with the now obsolete statement that "of all the chemical methods for the stabilization of sewage, only the chlorination method has come to be accepted."

The translation is better than average. It is correct and readable, but too literal in spots. There are too many rather bizarre words and phrases—such as "crawlable," "chutable," "skin pipes"(?), "power water," "valley dams" (for storage dams), "eternite" (for cement-asbestos concrete, known as "transite" in this country), and "duckers" (for inverted siphons). The liberty taken in translating the title of the book should have been followed in the rendering of the text, though perhaps with greater moderation. An engineering text is no legal or diplomatic document in which wording may be of the essence. What counts is the story—and that should be told in sturdy business-like American. In short, it should be told as the author himself would have told it, had English been his native language.

Geographical names occurring in the text are not always easily recognizable. Lake Tsade (p. 41) probably stands for the more familiar Lake Chad, and the thoroughly English Rothamsted (agricultural experiment station) comes back to us via the German original as Rothampstead—which is perhaps too English.

The book is supplied with extensive bibliographies, is amply indexed as to subjects (there is no name index) and profusely illustrated. In appearance it is a masterpiece of the publishing art and is superior to the German original.

The translation of this work is a most valuable contribution to American hydraulic engineering and the profession should be grateful for it. Let us hope that the John R. Freeman Trust Estate will be able to follow up its good work with similar publications presenting the practice and experience of other foreign countries to American engineers.

NEWS OF ENGINEERS

Personal Items About Society Members

Gordon F. Rogers, formerly superintendent of the Merritt-Chapman and Scott Corporation at San Pedro, Calif., is now with the Union Oil Company of California, with headquarters in the same city.

E. W. Bauman has resigned as engineer of materials and tests in the Tennessee State Highway Department to become highway materials engineer for the Republic Steel Corporation, in Cleveland, Ohio.

Herbert Hoover was awarded the honorary degree of doctor of laws by Colby College at a special convocation on November 8, 1937, honoring the centenary of the martyrdom of Elijah Parish Lovejoy.

J. Vernon Otter, until recently engineer-examiner for the PWA at Boise, Idaho, has been made manager of the Idaho Blueprint and Supply Company, with headquarters in the same city.

Frank P. Fifer, formerly principal engineer in the U. S. Engineer Office at Boston, Mass., has been transferred to the Binghamton, N.Y., district, where he is directing the design and construction of flood-control projects.

Edward H. Taylor is now an instructor in mechanical engineering at the University of California.

A. Lawrie Kurtz has established a private consulting practice in Milwaukee, Wis. He was formerly chief engineer in the Wisconsin office of the Public Works Administration.

Hugh Barnes, previously Kansas State Highway Engineer, is now connected with the Portland Cement Association. His headquarters are in San Francisco, Calif.

Richard Demarest has become junior air conditioning engineer for the Fitzgibbons Boiler Company, of New York City. He was formerly senior technician in a plumbing survey for the U. S. Department of Health and the WPA, in New York City.

Jerome W. Wood, until recently bridge engineer for the Berrien County (Mich.) Road Commission, is now with the Niles Steel Tank Company, at Niles, Mich.

Ira E. Taylor, for a number of years maintenance engineer for the Kansas State Highway Department, has joined the staff of the Scherrer and Bennett Construction Company, of Kansas City,

Kans., where he is employed on a rural electrification program.

Hugh H. Schmidt is now an assistant in the engineer corps of the Pennsylvania Railroad, with headquarters in Chicago, Ill. He was previously a draftsman in the Nebraska State Bureau of Roads and Irrigation.

Frederick H. Weed, formerly with Malcolm Pirnie, consulting engineer of New York City, has accepted a position as division engineer for the Water and Power Resources Board of the Commonwealth of Pennsylvania. He is located at Pittsburgh, Pa.

R. E. Lawrence has accepted a position with Black and Veatch, consulting engineers of Kansas City, Mo., where his work will be mostly in the field of sanitary engineering. For the past four years Mr. Lawrence has been connected with the Public Works Administration in Kansas—first as engineering-examiner and, later, as state director.

J. Y. Jewett, for eighteen years testing engineer for the city of San Diego, Calif., has established a consulting practice at Paso Robles, Calif., where he will specialize in problems in the field of testing materials.

Elliott J. Dent, formerly colonel, Corps of Engineers, U. S. Army, has retired after more than 40 years of active service, and has taken up his residence at 3403 Rodman Street, N.W., Washington, D.C. His last active duty station was Baltimore, Md., where he was district engineer, and at the same time a member of the Board of Engineers for Rivers and Harbors, the Beach Erosion Board, and the Shore Protection Board.

Earl J. Billingsley is now inspector on catenary construction for the Pennsylvania Railroad (the Paoli-Harrisburg Electrification Project), with headquarters at Downingtown, Pa. Until recently he was a junior engineer in the U. S. Engineer Office at New Bethlehem, Pa.

Stephen A. Derry has accepted a position as engineer instructor in the Service School Laboratory of the Firestone Tire and Rubber Company at Akron, Ohio. His former connection was with the Youngstown Sheet and Tube Company, Youngstown, Ohio, where he was field engineer.

Samuel Shulits, assistant professor of mechanics and hydraulics at the Colorado School of Mines, has been appointed to the Special Advisory Committee on Federal Soil Conservation Research.

Edward J. Hannigan, formerly structural steel inspector for the California State Highway Bridge Department, is now with the J. G. White Engineering Corporation at Maracaibo, Venezuela.

A. S. Bussey has resigned as junior civil engineering aide for the U. S. Waterways Experiment Station at Vicksburg, Miss., to become a junior engineer in the Industrial Department (Planning Division) of the New York Navy Yard.

Robert Linton, consulting engineer of Los Angeles, Calif., received the honorary degree of doctor of science from Washington and Jefferson College on Founder's Day, October 30, 1937.

James B. Hommon is now a transitman for the U. S. Bureau of Reclamation at Bartlett Dam, Cave Creek, Ariz.

Ralph C. Olander was recently transferred from the U. S. Forest Service to the Bureau of Biological Survey, with the position of construction engineer. His headquarters are at Kensal, N.Dak.

Raul Lucchetti, previously connected with the Puerto Rico Reconstruction Administration, is now in the Insular Department of the Interior, with headquarters at Hato Rey, P.R.

James A. Anderson, professor of civil engineering at Virginia Military Institute, has been made dean of the faculty.

William C. Merryman has resigned as resident engineer on subway construction for the Interborough Rapid Transit Company, of New York City, after thirty-seven years in that position.

R. E. Bakenhus, rear-admiral, Civil Engineer Corps, U. S. Navy (retired), has opened offices in New York City for the practice of consulting engineering.

W. K. Hatt, head of the civil engineering school and director of the Materials Testing Laboratory at Purdue University, was relieved of his administrative duties on July 1, 1937, for the purpose of organizing the Joint Highway Research Project between the Indiana State Highway Commission and Purdue University. Professor Hatt's duties at the university will be completed in June 1939 after forty-four years of service.

W. Compton Wills is now manager and chief engineer of the Water Department of Wilmington, Del. He was previously chief engineer of the department.

Datus E. Proper, until recently vice-president and general sales manager of the Uvalde Rock Asphalt Company, has been made executive manager of the Texas Good Roads Association, with headquarters at San Antonio, Tex.

Joseph M. Werblow, formerly assistant engineer of the P. T. Cox Contracting Company, of New York City, has accepted a position in a similar capacity with Arthur Gallow, Inc., of the same city.

Robert J. Alpher was recently transferred from the U. S. Department of Agriculture in Washington, D.C., to the Bureau of Air Commerce of the Department of Commerce, in Denver, Colo., where he is airways construction superintendent.

Yves Nubar, previously in the employ of the U. S. Treasury Department, Washington, D.C., is now connected with the Capitol Construction Company, of New York City.

Alexander Allaire is now regional engineer for the Public Works Administration at Fort Worth, Tex. He was formerly Arkansas State Director of the PWA at Little Rock, Ark.

William N. Cervino has terminated his connection with the Riparian Stream and Waterway Survey of Passaic County and accepted a position with the U. S. Geological Survey, Paterson, N.Y.

William L. Blankenburg, until recently teaching fellow at the University of North Carolina, is now an instructor in civil engineering at Washington University, St. Louis, Mo.

Arthur E. Spohn, formerly junior engineering field aide in the U. S. Soil Conservation Service at Salt Lake City, Utah, has become engineering assistant for the Bell Telephone Company of Pennsylvania. His headquarters are at Greensburg, Pa.

Charles E. Edwards has established a private consulting practice at 1431 Longfellow St., N.W., Washington, D.C. He was formerly treasurer and director of Francis R. Weller, Inc., consulting engineer of Washington, D.C.

Arthur S. Tuttle has resigned as New York State Director of the PWA to open an office for the practice of engineering at 10 East 40th Street, New York City.

Walter F. Schulz, construction and consulting engineer of Memphis, Tenn., has been named chairman of the Disaster Preparedness Committee of the local Red Cross.

Carl Wyant is now general manager of the Montecito County Water District at Santa Barbara, Calif. He was formerly supervising engineer for the U. S. Forest Service at Santa Barbara.

Elwyn E. Seelye and Gilbert D. Fish have formed a partnership to practice consulting engineering in the welding field, specializing in designs, inspection, estimating, and details. The office of the new firm is at 101 Park Avenue, New York City.

Norman M. Smith, rear admiral, C.E.C., U. S. Navy, is retiring at his own request after thirty-five years of service in the Navy. He recently completed a four-year period of duty as chief of the Bureau of Yards and Docks, Washington, D.C., and as chief of Civil Engineers of the Navy.

Lawrence B. Feagin, formerly senior engineer and assistant to the officer in charge of the Lock and Dam Section of the U. S. Engineer Office, St. Louis District, is now principal engineer in the U. S. Engineer Office, Nashville District, and principal civilian assistant to the district engineer.

Bruce D. Greenshields has resigned as professor of engineering science at Denison University to become an associate professor of civil engineering at the College of the City of New York.

Lee M. Bush, for the past six years city engineer of Oklahoma City, Okla., has established a civil engineering practice in that city, where he will specialize particularly in the fields of river control, pipe lines, and city planning.

James T. Mathews, commander, C.E.C., U. S. Navy, has assumed the post of public works officer of the 11th Naval District at San Diego, Calif. Previously he was stationed at the Bureau of Yards and Docks, Navy Department, Washington, D.C.

Bertram D. Tallamy, formerly assistant engineer of the Niagara Frontier Planning Board at Buffalo, N.Y., is now chief engineer, succeeding Frederick K. Wing who has resigned in order to devote more time to his private practice.

David J. Peery has been appointed instructor in mechanics at the Carnegie Institute of Technology. He was previously instructor in civil engineering at the Missouri School of Mines and Metallurgy.

Oscar S. Smith, who has been serving as regional labor adviser for the Resettlement Administration at Indianapolis, Ind., is now an examiner for the National Labor Relations Board, with headquarters in Chicago, Ill.

James G. Steese, chairman of the board and president of Guajillo Corporation and Affiliated Companies, of San Antonio, Tex., has been elected president of Slate Creek Placers, Inc., Valdez, Alaska.

Paul MacMurray is now employed as an assistant engineer in the Philadelphia Bureau of Street Cleaning. He was formerly in the U. S. Engineer Field Office at Schuylkill Haven, Pa.

DECEASED

William Delano Armstrong (M. '29) bridge engineer for Los Angeles County, Los Angeles, Calif., died on November 5, 1937, at the age of 65. Mr. Armstrong was born in Honolulu, Hawaii, and was educated at Oahu College. His early career included experience as a draftsman for the Honolulu Iron Works, the Pacific Electric Railway, the Los Angeles Railway, and the U. S. Bureau of Reclamation. In 1909 he became connected with the Los Angeles County Highway Commission—until 1914 in charge of design, then as senior bridge draftsman, and finally (1924 on) as bridge engineer.

Robert Andrew Cairns (M. '95) city engineer of Waterbury, Conn., died there on November 22, 1937, at the age of 78. Mr. Cairns was born in Waterbury and educated at Rensselaer Polytechnic Institute. Following his graduation in 1885, he remained at Rensselaer for two years as instructor in mechanical drawing. From 1887 to 1888 he was mechanical engineer for the Ludlow Valve Manufacturing Company, and from 1888 to 1890 he was engaged in building water works in Maryland and Delaware. From 1890 until his death he was city engineer of Waterbury. Mr. Cairns was often engaged by manufacturing companies and municipalities, and he also designed and constructed a large number of dams and water works.

Watson Gerould Clark (M. '06) civil engineer of Tenafly, N.J., died at his home there on December 7, 1937, at the age of 66. Mr. Clark was born at Cresskill, N.J., and educated at New York University. From the time of his graduation (1891) until 1896 he was in the office of Charles B. Brush, of Hoboken, N.J., as transitman, inspector, and chief of party on numerous construction projects. In 1899 he was appointed borough engineer of Tenafly, in which capacity he was in charge of the construction of many municipal improvements. He served four years as a member of the New Jersey Highway Commission and for several years before his death was assistant state director of the U. S. Coast and Geodetic Survey. For many years Mr. Clark was head of the civil engineering firm of Watson G. Clark, Inc., of Tenafly.

Verne Louis Conrad (Assoc. M. '20) consulting engineer of Brownsville, Tex., died there on November 24, 1937, at the age of 58. Mr. Conrad was born at Bellaire, Ohio, and educated at Ohio State University. From 1902 to 1908 he was connected with the Pennsylvania Railroad, and from 1908 to 1910 he engaged in general engineering practice in the Lower Rio Grande Valley of Texas. From 1910 to 1914 Mr. Conrad was supervising engineer for the Union Irrigation District; from 1914 to 1916, county engineer of Cameron County, Texas; and from 1916 to 1927, engaged in general engineering practice. From the latter year until his death he was consulting engineer for Cameron County Water Districts Nos. 8, 10, 11, and 17.

Theodore Christian Fischer (Assoc. M. '07) auditor of disbursements for the Central Railroad of New Jersey, Jersey City, N.J., died at his home in Elizabeth, N.J., on November 8, 1937. He was 58. Mr. Fischer was born in Philadelphia, Pa., and educated at Rutgers University, graduating in 1899. Later in the same year he entered the employ of the Central Railroad of New Jersey where he spent his entire career—as rodman to office engineer from 1899 to 1919; corporate engineer, 1919 to 1920; accounting engineer, 1920 to 1926; and auditor of disbursements from 1926 on.

Frazer Croswell Hilder (M. '24) associate structural engineer in the office of the Supervising Architect, Treasury Department, Washington, D.C., died several months ago. Mr. Hilder was born in St. Louis, Mo., on January 16, 1881, and graduated from the University of Missouri in 1904. From 1909 to 1916 he was office engineer in the Office of Indian Affairs, Washington, D.C., and from 1916 to 1926, structural designer in the Bureau of Yards and Docks. In 1926 he became associate structural engineer in the office of the Supervising Architect. During the war Mr. Hilder served overseas as captain and, later, as major in the Corps of Engineers, U. S. Army.

Richard Frederick Hoffmark (M. '29) since 1932 general manager of the Woods Brothers Construction Company, Lincoln, Nebr., died in that city on November 29, 1937, at the age of 54. Mr. Hoffmark was born in Bremen, Germany, and educated at Purdue University. Following his graduation in 1906, he spent a year as rodman and leveler for the Isthmian Canal Commission, and from 1907 to 1910 held a variety of positions with the Panama Railroad. He was with the Oregon Trunk Railway from 1910 to 1914, when he joined the staff of A. Guthrie and Company, of Portland, Ore. Mr. Hoffmark remained with this organization until 1932, serving as superintendent and, later, as vice-president. He was superintendent in charge of the construction of the Great Northern Railway Company's eight-mile tunnel through the Cascades near Scenic, Wash.

Charles Raymond Hulsart (Assoc. M. '11) for the past sixteen years vice-president of the Atlas Lumnite Company, New York City, died in New Rochelle, N.Y., on November 30, 1937. Major Hulsart, who was 54, was born in Sea Bright, N.J., and graduated from New York University in 1905. Beginning in 1906, he was for a number of years with the New York City Board of Water Supply. During the war he served as captain in command of B Company of the Eleventh Engineers, receiving the British Military Cross and the American Distinguished Service Cross. He was also promoted to the rank of major. After the war he entered the private practice of engineering and, for a time, was vice-president of the Cement Manufacturers' Protective Association. In 1921 he became connected with the Atlas Lumnite Company.

Lasley Lee (M. '27) district engineer for the U. S. Geological Survey, Water Resources Branch, Columbus, Ohio, died there on November 15, 1937. Mr. Lee was born at Carbondale, Pa., on January 2, 1887, and graduated from Massachusetts Institute of Technology in 1910. From 1910 to 1911 he was assistant engineer in the city engineer's office, Sioux City, Iowa. In the latter year he became hydraulic engineer for the U. S. Geological Survey and was located, successively, in San Francisco, Washington, and Tacoma. In 1921 he became district engineer at Columbus. Mr. Lee was in charge of the water-resources investigations in Ohio conducted by the U. S. Geological Survey in cooperation with the State of Ohio.

Raymond Stanton Patton (M. '21) for over eight years director of the U. S. Coast and Geodetic Survey, Washington, D.C., with the rank of rear admiral, died on November 25, 1937, at the age of 54. He was born at De Graff, Ohio, and educated at Western Reserve University. Following his graduation in 1904, he entered the U. S. Coast and Geodetic Survey, for which he engaged on field surveys on the Atlantic and Pacific coasts of the United States, Alaska, and the Philippines as subordinate and later as chief of party and commanding officer of survey vessels. He was chief of the Coast Pilot Section from 1915 to 1917 and lieutenant and lieutenant commander in the U. S. Navy during the war. From 1919 to 1929 he was in charge of chart production and correction, becoming director in the latter year. Admiral Patton was the author of many articles.

Reuben Sylvester Peotter (M. '17) an engineer for the Atlantic, Gulf and Pacific Company, was found dead on Van Vliet Lake, Wisconsin, where he had gone to hunt ducks, on October 23, 1937. He was 56. Mr. Peotter was born at Black Creek, Wis., and graduated from the University of Wisconsin in 1905. In 1911, after early

experience with several power companies in this country and Canada and as an instructor in the University of Wisconsin and the Polytechnic Institute of Brooklyn, he became connected with various subsidiaries of the Aluminum Company of America. He remained with this organization until 1919—part of the time as managing director of the Demerara Bauxite Company in British Guiana—when he left engineering to go into financial work in Milwaukee. Early in 1937 he reentered his profession and made a trip to South America for the Atlantic, Gulf and Pacific Company, returning shortly before his death.

EMORY DOUGLAS ROBERTS (M. '36) professor and head of the department of civil engineering at Marquette University, Milwaukee, Wis., died on November 23, 1937. Professor Roberts was born in Portland, Ore., on December 4, 1889, and was educated at Oregon State College and Marquette University. From 1909 to 1918 he was with the Union Pacific Railway, holding all positions from chainman to assistant engineer; from 1918 to 1920, field assistant to the Portland, Ore., Commissioner of Public Works; and from 1920 to 1924, instructor and assistant professor of civil engineering at Oregon State College. In the latter year he was appointed assistant professor of civil engineering at Marquette University, where he later became professor and head of the department. From 1924 to 1930 Professor Roberts also maintained a consulting practice.

WILSON FITCH SMITH (M. '12) vice-president of the Dutchess Bleachery Inc., and Rockland Finishing Company, New York, N.Y., died there on November 29, 1937. Mr. Smith, who was 66, was born in New York City and graduated from the Columbia School of Mines in 1894. From 1900 to 1906 he was assistant engineer for the New York Rapid Transit Commission, and from 1906 to 1917 he was division engineer for the New York Board of Water Supply in charge of the construction of Kensico Dam and Reservoir. During the war he was resident engineer for the Division Shipyard Plant of the U. S. Shipping Board, and later he served as assistant to the general manager of the Merchant Shipbuilding Corporation at Bristol, Pa. From 1923 to 1925 he was chief engineer on the construction of the Bear Mountain Bridge across the Hudson River. In the latter year he became connected with the Dutchess Bleachery, Inc., and Rockland Finishing Company.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

WICK WICKSTROM (Assoc. M. '34) president and general manager of the Skandia-Verken, Aktiebolag, Lysekil, Sweden, died on August 20, 1937, at the age of 38. Mr. Wickstrom was born at Karlskrona, Sweden, and graduated from Chalmers Institute of Technology in 1918. He came to this country in 1923 after several years of engineering experience with various manufacturing companies in Sweden. From 1923 to 1924 he was an engineer for Stoner, Gallagher and Groos, Inc., of San Antonio, Tex., and from 1924 to 1925 designer for the American Machine and Foundry Company, in Brooklyn, N.Y. In 1925 he became connected with Warren and Arthur Smadback, Inc., of New York City—as assistant chief engineer until 1929 and as chief engineer from 1930 to 1936.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From November 10 to December 9, 1937, Inclusive

ADDITIONS TO MEMBERSHIP

ADAMS, WILLIAM SOLOMON (Assoc. M. '37), Res. Engr., State Highway Comm., Parsons, Kans.

ALWART, HAROLD JOHN (Jun. '37), Engr., McCracken Const. Co. (Res., 3436 North Leavitt St.), Chicago, Ill.

ANDERSON WILBUR STOCKER (Jun. '37), 4030 Lawn Ave., Western Springs, Ill.

ANDRUS, JOSEPH WESLEY (Jun. '27), Marion, via Kamas P.O., Utah.

BALDWIN, CHARLES RICHARD (Jun. '37), Luray, Va.

BARRETT, WILLIAM SCOTT (Jun. '37), 1902 University Ave., Austin, Tex.

BEATTIE, NORVAL WILSON (Jun. '37), 605 North 13th, Milwaukee, Wis.

BENGI, NECDET AHMED (Jun. '37), 1716 Cambridge St., Cambridge, Mass.

BISTLINE, SAMUEL ELDON (Jun. '37), Draftsman, Eng. Dept., P.R.R., Pittsburgh (Res., 1443 Foliage St., Wilkinsburg), Pa.

BONNER, JOHN FOSTER (Jun. '37), Hydrographer, Pacific Gas & Elec. Co., San Francisco (Res., 100 Manor Drive, Piedmont), Calif.

BORG, GRANT KENNETH (Jun. '37), 356 University St., Salt Lake City, Utah.

BRANDT, CHESTER CHARLES (Jun. '37), 1910 Washington St., Davenport, Iowa.

BAUNACH, ROBERT WILLIAM (Jun. '37), 433 Wilden Pl., South Orange, N.J.

BRETSCHER, ERWIN RUDOLPH (Jun. '37), 1002 West 24th St., Pine Bluff, Ark.

BURKEBILE, FREDERICK VERNON (Jun. '37), Route 3, Box 844, Everett, Wash.

CALLAHAN, FELIX WOOD (Jun. '37), Dist. Supervisor of Operations, WPA, Dist. 19 (Res., 421 North Adams), San Angelo, Tex.

CANHAM, CHESTER HAROLD (Jun. '37), Asst. San. Engr., State Dept. of Health, Louisville, Ky.

CARR, JOHN ROLAND (Assoc. M. '37), Designer, State Highway Dept., 3520 Capitol Ave., Cheyenne, Wyo.

CAVIN, HAROLD DANIEL (Assoc. M. '37), Cons. Industrial Engr. (Cavin, Marshall & Barr), 801 Seventeenth St., Bellingham, Wash.

CONFORTI, JAMES, JR. (Jun. '37), 2798 Pond Pl., New York, N.Y.

COOPER, CARL COLMAN (Jun. '37), Technical Insp., Grand Coulee Dam, 1726 Fifteenth Ave., Seattle, Wash.

COTTER, AUGUSTINE JOSEPH (Assoc. M. '37), Res. Engr. Insp., PWA, 920 Pickering St., Ogdensburg, N.Y.

CROOK, STANLEY FRANKLIN (Jun. '37), Box 6, Station G, Buffalo, N.Y.

CRUICKSHANKS, JOHN STIRLING, JR. (Jun. '37), 1614 Wilmington Ave., Richmond, Va.

DAIL, LAWRENCE RUFUS (Assoc. M. '37), Engr., Pleasant-Hasler Constr. Co., Box 871, Yuma, Ariz.

DALLAS, JAMES LORNIE (Jun. '37), 44 Butman St., Beverly, Mass.

DARBY, WILLIAM DANIEL (M. '37), City Engr. (Res., 1505 South 82d St.), West Allis, Wis.

DAVENPORT, ROBERT EUGENE (Jun. '37), 24 Argyle Park, Buffalo, N.Y.

DIETER, FRANK LOUIS (Assoc. M. '37), Civ. Engr., FSA, 2537 North 89th St., Wauwatosa, Wis.

D'ONOFRIO, MICHAEL DANIEL (Jun. '37), 189 Chapman St., Orange, N.J.

DOWNS, ROSCOE PHILLIPS (Assoc. M. '37), Care, Met. Constr. Co., 208 West 8th St., Los Angeles, Calif.

DOZIER, LOUIS SANFORD (Assoc. M. '37), Gen. Supt., H. E. Turner Constr. Co., Box 57, Dalton (Res., 211 Twelfth Ave., East, Cordele), Ga.

DUGGINS, CHARLES STUART (Assoc. M. 37'), 108 Seneca Rd., Richmond, Va.

EHLERS, JOSEPH HENRY (M. '37), Liaison Officer, PWA (Res., 4000 Cathedral Ave.), Washington, D.C.

ELAM, DANIEL FRANK (Jun. '37), Care, International Geophysics, Inc., Box 188, Lovington, N.Mex.

EPPLER, WILLIAM GEORGE (Jun. '37), 16 Elmwood Ave., Bloomfield, N.J.

ESTES, CLAUD WILLIAMSON (Assoc. M. '37), Asst. County Engr., Fort Worth (Res., 213 Rogers St., Arlington), Tex.

FELD, MYRON XANE (Jun. '37), Asst. Eng. Aide, War Dept., U. S. Engr. Office, 39 Whitehall St., New York, N.Y. (Res., Jersey Homesteads, Hightstown, N.J.)

FERNS, JOHN HAMILTON (Jun. '37), Senior Eng. Field Aid and Junior Highway Engr., Bridge Dept., Div. of Highways, Paraiso Springs, Calif.

FEY, REGIS FLORIAN (Jun. '37), 1334 Olivant St., Pittsburgh, Pa.

FINE, HYMAN JOSEPH (Assoc. M. '37), Asst. Engr., U. S. Engr. Office, 415 Post Office and Court House, Norfolk, Va.

FLANNAGAN, OSCAR BROADUS (Assoc. M. '37), Chf. Engr., Celestino Joaristi y Compañia, Monte 377, Havana, Cuba.

FLUX, PAUL ALBERT EDWARD (M. '37), With State Highway Dept., Bridge Div., 24 Proctor Rd., Manchester, Conn.

FORTNEY, CAMDEN PAGE, JR. (Jun. '37), Res. Engr., City Incinerator, for C. P. Fortney, 1554 Quarrier St., Charleston, W.Va.

FRARACCIO, PASCO (Jun. '37), 68 Bancroft St., Providence, R.I.

FREUDENTHAL, ALFRED (Assoc. M. '37), Senior Structural Engr., The Tel Aviv Harbour and Communication Council, 39 Reines St., Tel Aviv, Palestine.

FRIEND, HAROLD LLOYD (Assoc. M. '37), Asst. Engr., U. S. Forest Service (Res., 6316 Second St., N.W.), Washington, D.C.

GALE, CLARENCE STEPHENS, JR. (Jun. '37), Care, Southern Bell Telephone & Telegraph Co., Savannah, Ga.

German, Robert Monroe (Jun. '37), Junior Engr., U. S. Waterways Experiment Station, Box 80, Vicksburg, Miss.

Gillam, William Alfred (Jun. '37), Box 218, Coulee Dam, Wash.

Goodale, Arthur Worthington (Jun. '37), 33 Front St., Dover, N.J.

Hale, Lucius Melvin (Jun. '37), 263 West Center St., Logan, Utah.

Hardy, William Ralph (Jun. '37), Box 82, Mineral Wells, Tex.

Hass, Arthur Edward (Jun. '37), Care, Eng. Div., Cities Service Oil Co., Bartlesville, Okla.

Heitz, William Sneddon (Jun. '37), Care, Indian Service, Fort Washakie, Wyo.

Hickman, Richard Edgar (Jun. '37), Eng. Draftsman, TVA (Res., 2513 Parkview Ave.), Knoxville, Tenn.

Hopkins, Bryant Lealand (M. '37), Hydr., Engr., Brassua Associates and Kennebec Water Power Co., Bangs Station, Waterville, Me.

Howard, Paul Frederick (M. '37), San. Engr., Whitman & Howard, 89 Broad St., Boston, Mass.

Jackson, James Allen (Jun. '37), Care, Dist. Health Dept., Huntingburg, Ind.

Jackson, Robert James, Jr. (Jun. '37), 480 Park Ave., Weehawken, N.J.

Jenks, Downing Bland (Jun. '37), Eng. Apprentice, M. of W. Dept., Drawing Room, P.R.R., Y.M.C.A., Easton, Pa.

Johnson, Irwin Twining (Assoc. M. '37), Res. Engr., State Div. of Highways, Bridge Dept., 596 California St., Palo Alto, Calif.

Kirpich, Zalmon (Jun. '37), Junior Engr., U. S. Engr. Office, 1st Dist., New York (Res., 2221 Sixty-Second St., Brooklyn), N.Y.

Kous, Nicholas Simon (Assoc. M. '37), Gen. Contr. (Kous Constr. Co.), 152 West 42d St. (Res., 215 West 101st St.), New York, N.Y.

Kyser, John Lewis (Jun. '37), Care, Eng. Dept., Phillips Petroleum Co., Bartlesville, Okla.

Laine, Leo Lauri (Jun. '37), Junior Engr., U. S. Geological Survey, Box 1691, Memphis, Tenn.

Le Tellier, Louis Shepherd (M. '37), Head, Dept. of Civ Eng., The Citadel, Charleston, S.C.

Lieberman, Norman (Jun. '37), 217 East Chestnut St., Mount Vernon, Ohio.

Linsley, Ray Keyes, Jr. (Jun. '37), 1926 Highland Ave., Knoxville, Tenn.

Lipschutz, Daniel (Jun. '37), Junior Draftsman, State Highway and Public Works Comm. (Res., 116 Groveland Ave.), Raleigh, N.C.

Locantore, Stephen Sylvester (Jun. '37), 4623 Park Ave., New York, N.Y.

Lockwood, Bradley Franklin, Jr. (Jun. '37), Instr., Applied Science Dept., Univ. of South Dakota, 215 North Willow St., Vermillion, S.Dak.

Longhi, Edward John (Jun. '37), 126 South 12th Ave., Mount Vernon, N.Y.

Lovell, Leonard Arthur (Assoc. M. '37), Office Engr., Platte Val. Public Power and Irrig. Dist. (Res., 618 South Pine St.), North Platte, Nebr.

Lytle, William John (Jun '37), 6020 Drexel Ave., Chicago, Ill.

McCaffrey, William Theodore (Jun. '37), With Am. Bridge Co. (Res., 37 Maple Ave.), Trenton, N.J.

McClure, William Carter (Jun. '37), Graduate House, Mass. Inst. Tech., Cambridge, Mass.

McCord, Marshal (Jun. '37), Care, Modjeski & Masters, State Street Bldg., Harrisburg, Pa.

McGinnity, William James (Assoc. M. '37), Hamilton Hall B36, Soldiers Field, Boston, Mass.

McKnight, Clair Jeffries (Assoc. M. '37), Engr., Drainage Products Div., The Armco International Corporation (Res., 2903 Fleming Rd.), Middletown, Ohio.

Mapes, Joe Burkett (Jun. '37), With State Highway Dept., Box 626, Post, Tex.

Mariner, Hobart Graham (Jun. '37), 748 Washington Boulevard, Kansas City, Kans.

Mark, Donald William (Jun. '37), 1073 Lincoln Ave., St. Paul, Minn.

Marshall, Robert Frederick Merrick (Assoc. M. '37), Designing Engr., The Foundation Co. of Canada, Ltd., Sherbrooke and Guy, Montreal, Que., Canada.

Mayer, David (Jun. '37), Research Asst., Mass. Inst. Tech., Room 5-229, Mass. Inst. Tech. (Res., 95 Prescott St.), Cambridge, Mass.

Meenan, James Gallagher (Jun. '37), 1132 Jancey St., Pittsburgh, Pa.

Miller, Edward Luther (Jun. '37), 502 West 30th St., Wilmington, Del.

Mohr, Charles Milton (Jun. '37), 1428 North 29th St., Birmingham, Ala.

Montgomery, Robert Grove (Jun. '37), 520 Benjamin Ave., S.E., Grand Rapids, Mich.

Moore, Paul Lehmann Glenn (Jun. '37), 4545 Woodlawn Ave., Chicago, Ill.

Moser, Francis (Jun. '37), 119 North Sycamore, Albuquerque, N.Mex.

Moulton, John Jesse (Jun. '37), Asst. Mgr., Montpelier and Wells River Railroad, 7 Main St. (Res. 45 Barre St.), Montpelier, Vt.

Mowrer, Jesse Dee (Jun. '37), White River, Ariz.

Nagel, William Brock (Jun. '37), Junior Procurement. Insp., Material Div., U. S. A. Air Corps. 55 Nottingham Rd., Dayton, Ohio.

Osoffsky, Jake (Jun. '37), 1416 Twenty-Third St., Sacramento, Calif.

Palmer, Robert Kent (Jun. '37), 239 North Elm St., Schenectady, N.Y.

Pietrangelo, Albert Philip (Jun. '37), 213 East Hamtramck St., Mount Vernon, Ohio.

Pitman, Edwin Price (Assoc. M. '37), Asst. Engr. of Inspection, The Port of New York Authority, New York, N.Y. (Res., 27 Burnett Terrace, Maplewood, N.J.)

Preston, Howard Kent, Jr. (Jun. '37), Detailer, Am. Bridge Co. (Res., 30 Woodside Ave.), Trenton, N.J.

Reeves, Harry Milton (Assoc. M. '37), With TVA (Res., 41 West Circle Rd.), Norris, Tenn.

Reinhardt, Arthur William (Jun. '37), 830 Montrose Ave., South Pasadena, Calif.

Richards, John Ashhurst (Jun. '37), Box 58, Pottsville, Pa.

Ross, Austin Holmes (Jun., '37), 38 Bowdoin St., Cambridge, Mass.

Rowny, Edward Leon (Jun. '37), Company A, U. S. C. C., West Point, N.Y.

Royce, Thomas Cochran (Jun. '37), 1814 N St., Sacramento, Calif.

Rubey, Thomas Harden (Jun. '37), 402 South 5th, Ponca City, Okla.

Saenz, Mateo (Jun. '37), 36 Ellwood St., New York, N.Y.

Saltman, Murdie (Jun. '37), Box 75, High Island, Tex.

Scheible, Albert Edward (Assoc. M. '37), Prin. Asst. Engr., R. D. MacDowell (Res., 4192 West 36th St.), Cleveland, Ohio.

Schweser, Gilbert Constant (Jun. '37), Senior Foreman, National Park Service, 303 South Sycamore, North Platte, Nebr.

Seeley, Ralph Kinne (June. '37), 903 East Terrace, Chattanooga, Tenn.

Segal, William Howard (Jun. '37), Junior Engr., U. S. Engr. Office (Res., 325 Madison St.), New York, N.Y.

Senecal, Henry Jess, Sr. (Assoc. M. '37), With Bethlehem Steel Co., Fabricated Steel Constr., Bethlehem (Res., 1305 Main St., Hellertown), Pa.

Smith, Wilbur Stevenson (Jun. '37), Traffic Engr., State Highway Dept. (Res., 3100 Hunter St.), Columbia, S.C.

Stamm, George Woodrow (Jun. '37), 3017 Lafayette Ave., St. Louis, Mo.

Steinman, Jesse (Jun, '37), Detailer, Am. Bridge Co., Ambridge Plant, Ambridge (Res., 815 Hill St., Sewickley), Pa.

Subkowsky, Abraham (Jun. '37), 740 East 243d St., New York, N.Y.

Sulahian, Setrag (Assoc. M. '37), Asst. Engr. of Constr., WPA, Queens Highway Dept., 443 Sixty-Fourth St., Brooklyn, N.Y.

Suominen, Wilho Nestor (Jun. '37), Detailer, Am. Bridge Co., Ambridge (Res., 624 Mulberry St., Sewickley), Pa.

Sweet, Charles Alvin (Jun. '37), Insp., Met. Water Dist. of Southern California, Div. 3 Headquarters, Indio, Calif.

Taggart, Daniel Brown (Jun. '37), 608 North 2d St., Harrisburg, Pa.

Teilman, Ingvart Holm (M. '37), Chf. Engr. and Mgr., Consolidated Irrig. Dist. (Res., 2110 Merced St.), Selma, Calif.

Thomas, Roy James (Jun. '37). Prin. Eng. Aid, TVA, Dept. of Operations, Wilson Dam, Ala.

Thompson, William Jefferson (Jun. '37), Draftsman, Lines East, C. B. & Q. R. R., Chicago (Res., 110 North Spring Ave., La Grange), Ill.

Tourtellot, Irving Williams (Jun. '37), 512 West Grand Boulevard, Detroit, Mich.

Towers, Richard Rutfred (Jun. '37), 174 Jolbert St., Berlin, N.H.

Underhill, Edward Griffin (Jun. '37), 2108 Versailles Ave., McKeesport, Pa.

Vartia, Karl Olavi (Jun. '37), Junior Patent-Examiner, U.S. Patent Office (Res., 1526 Seventeenth St., N.W.), Washington, D.C.

Vaughan, Norman Ernest (Assoc. M. '37), Asphalt Dept. Mgr., Vacuum Oil Co., Pty. Ltd., 29 Market St., Melbourne, C. 1, Victoria, Australia.

Walker, John Ben (M. '37), Executive Secy. and Senior Engr., Board of Engrs. for Rivers and Harbors, War Dept. (Res., 2929 Connecticut Ave., N.W.), Washington, D.C.

Ward, James Raymond (Jun. '37), 1612 Park St., Greenville, Tex.

Warren, Moultrie Alfred (Jun. '37), 1400 Baum St., Vicksburg, Miss.

Webster, Ralph Patterson, Jr. (Jun. '37), 99 Meriam St., Lexington, Mass.

Weers, Carl Anton (Jun. '37), 915 Carmen Ave., Chicago, Ill.

Willard, Walter Edward (Jun. '37), 277 Linden Park Pl., Highland Park, Ill.

Williams, Leonard Oliver, Jr. (Assoc. M. '37), State San. Engr., State Dept. of Health, 3914 House Ave., Cheyenne, Wyo.

Williams, Roy Bruce (M. '37), Constr. Engr., U. S. Bureau of Reclamation, Washington, D.C.

Winn, Harlan Frank (Jun. '37), Research Asst., Purdue Univ., La Fayette (Res., 134 Andrew Pl., West Lafayette), Ind.

Witbeck, Horace Malcolm (Jun. '37), 620 Santa Clara Ave., Alameda, Calif.

Wood, Paul Breese (Jun. '37), Surveyman, U. S. Engrs., Louisville (Res., 630 North 35th St., Paducah), Ky.

Zuck, Gerald W. (Jun. '37), R. R. 1, Kingman, Ind.

Membership Transfers

Alden, Langford Taylor (Assoc. M. '14; M. '37), With The J. G. White Eng. Corporation, 80 Broad St. (Res., 75 Riverside Drive), New York, N.Y.

Appel, Theodore Burton, Jr. (Jun. '29; Assoc. M. '37), Associate Struc. Engr., T.V.A., Knoxville (Res., 110 Rennoc Rd., Fountain City), Tenn.

Bryant, Charles Byrn (Jun. '25; Assoc. M. '29; M. '37), Engr. of Tests, Southern Ry. System (Res., 3 Fort Hunt Rd.), Alexandria, Va.

Carlin, Philip Henry (Assoc. M. '30; M. '37), Editor, Civil Engineering, Am. Soc. C. E., 33 West 39th St., New York, N.Y.

Clements, James Strong, Jr. (Jun. '26; Assoc. M. '37), Asst. Res. Engr., State Highway Dept., General Delivery, Pearsall, Tex.

Dalrymple, Tate (Jun. '32; Assoc. M. '37), Junior Engr., Water Resources Branch, U. S. Geological Survey, Room 300, State Highway Bldg., Austin, Tex.

Donaldson, Arthur (Assoc. M. '26; M. '37), Job Engr. in Chg., Columbia Constr. Co., Bonneville, Ore.

Ferguson, Phil Moss (Jun. '26; Assoc. M. '31; M. '37), Associate Prof., Civ. Eng., Univ. of Texas, Box 1729, University Station, Austin, Tex.

Glassberg, Myron (Jun. '31; Assoc. M. '37), (Construction Specialties Co.), 317 North 11th, St. Louis, Mo.

Harvey, Alfred Dallas (Assoc. M. '29; M. '37), Gen. Mgr., Spillway Builders, Inc., 235 Ward Parkway, Kansas City, Mo.

Johnson, Arthur Fayette (Jun. '30; Assoc. M. '37), Asst. Engr., U. S. Bureau of Reclamation, Denver, Colo.

Johnson, Berkeley (Assoc. M. '25; M. '37), Dist. Engr., U. S. Geological Survey, Room 3, U. S. Court House, Sante Fé, N.Mex.

Jones, Carl Roemer (Jun. '35; Assoc. M. '37), Lieut., Corps of Engrs., Post of Corozal, Corozal, Canal Zone.

Karrer, Wilfred Leonard (Jun. '29; Assoc. M. '37), Associate Engr., U. S. Bureau of Reclamation, Box 767, Boise, Idaho.

Koch, Victor George (Jun. '23; Assoc. M. '26; M. '37), Asst. Div. Engr., State Highway Dept., Box 29, Lufkin, Tex.

Long, Gordon Lucas (Jun. '30; Assoc. M. '37), Asst. Bridge Constr. Engr., State Div. of Highways, Bridge Dept. (Res., 5024 Thirteenth Ave.), Sacramento, Calif.

Molineaux, Charles Borromeo (Assoc. M. '28; M. '37), Chf. Engr., The Arthur A. Johnson Corporation, 704 Sixth Ave., New York (Res., 85-28 Wareham Pl., Jamaica), N.Y.

Ortolani, Lawrence (Jun. '29; Assoc. M. '37), Res. Engr., State Highway Dept. Box 324, Cleburne, Tex.

PEUGH, VERNE LEON (Assoc. M. '30; M. '37), Chf. Engr., Morrison-Utah-Winston-Lawler, Box 494, Seminoe Dam, Wyo.

PILKEY, ORRIN HENDREN (Jun. '30; Assoc. M. '37), With Chicago Bridge & Iron Co., 1305 West 105th St., Chicago, Ill.

QUINN, FRANK TAYLOR, JR. (Jun. '26; Assoc. M. '37), Asst. Works Mgr., Layne & Bowler, Inc. (Res., 867 Harrison St.), Memphis, Tenn.

RASMUSSEN, RASMUS (Assoc. M. '21; M. '37), Dist. Mgr., Bates & Rogers Constr. Co., 532 Russ Bldg. (Res., 2090 Broadway), San Francisco, Calif.

SCHROEDER, ROBERT ARMENAC (Jun. '20; Assoc. M. '23; M. '37), Asst. to Vice-Pres., Gen. Motors Corporation, 1775 Broadway, New York, N.Y.

STARK, ARTHUR HENRY (Jun. '27; Assoc. M. '37), Asst. Structural Engr., Cuyahoga County Bridge Dept., 1936 Standard Bldg., (Res., 4800 West 19th St.), Cleveland, Ohio.

THELIN, CARL MILO (Assoc. M. '34; M. '37), Designing Engr., City of Fort Worth, Care, Dept. of Eng., City Hall, Fort Worth, Tex.

THOMAS, MARK EVERETT (Jun. '26; Assoc. M. '37), Dist. Finance Officer, Northwestern Camp P-205, Willits, Calif.

UHR, SAUL (Assoc. M. '28; M. '37), Res. Engr.-Insp., PWA (Res., 5101 North 12th St.), Philadelphia, Pa.

VAN EENAM, NEIL (Jun. 19; Assoc. M. '22; M. '37), Associate Highway Bridge Engr., U. S. Bureau of Public Roads, 1725 F St., N.W. (Res., 4973 Butterworth Pl., N.W.), Washington, D.C.

WEIDNER, CHARLES KENNETH (Jun. '36; Assoc. M. '37), Asst. Supt. of Buildings and Grounds, Univ. of Washington (Res., 4746 Twenty-First Ave., N.E.), Seattle, Wash.

WITZEL, STANLEY ARTHUR (Jun. '28; Assoc. M. '37), Asst. Prof. and Extension Engr., Agri. Eng. Dept., Univ. of Wisconsin, Madison, Wis.

REINSTATEMENTS

GAYÁ-BENEJAM, RÚAL, Assoc. M., reinstated Nov. 22, 1937.

MENGEL, CARL WAYNE, Assoc. M., reinstated May 17, 1937.

OHLSEN, EDWARD HENRY, Assoc. M., reinstated July 12, 1937.

PRICE, WRIGHT MOORE, Assoc. M., reinstated Nov. 22, 1937.

THOMAS, CYRIL, Assoc. M., reinstated May 17, 1937.

RESIGNATIONS

ADAMS, EVERETT EUGENE, Assoc. M., resigned Nov. 10, 1937.

ALLARDICE, ELLIOT RITCHIE BARCLAY, Assoc. M., resigned Dec. 7, 1937.

BENSON, CHARLES GREENWOOD, Assoc. M., resigned Nov. 29, 1937.

BUCHER, HAROLD FOLLMER, Assoc. M., resigned Nov. 29, 1937.

GLESSNER, CHARLES BOOTH, Jun., resigned Dec. 1, 1937.

HANSEN, CARL VALDEMAR, M., resigned Dec. 2, 1937.

MCGIFFERT, CROSBY JAQUITH, Assoc. M., resigned Nov. 24, 1937.

MERZ, ROBERT H., Jun., resigned Dec. 8, 1937.

ROBERTS, RICHARD FRANCIS, Assoc. M., resigned Dec. 1, 1937.

SAULT, LEON HERBERT, M., resigned Nov. 9, 1937.

SELBY, OSCAR ELLSWORTH, Jun., resigned Nov. 19, 1937.

VESSELL, FRANK G., Jun., resigned Nov. 9, 1937.

WHITE, OMAR WASHBURN, Assoc. M., resigned Nov. 24, 1937.

WOODWARD, HAROLD STONE, Assoc. M., resigned Nov. 24, 1937.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

January 1, 1938 NUMBER 1

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years†	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.

† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

ADMISSIONS

AHERNE, JAMES BARTHOLOMEW, Corona, N.Y. (Age 21.) Refers to J. J. Costa, A. V. Sheridan.

AIKIN, HENRY BOBBITT, Knoxville, Tenn. (Age 42.) Asst. Prof. of Civ. Eng., Univ. of Tennessee. Refers to C. N. Bass, R. T. Brown, N. W. Dougherty, P. J. Freeman, H. H. Hale, G. E. Tomlinson, I. L. Tyler.

ALBERT, JOSEPH LOGSDON, Cheyenne, Wyo. (Age 23.) Asst. Engr., North Platte Defense, State of Wyoming. Refers to E. W. Burritt, G. C. Dillman, J. A. Elliott, E. K. Nelson, H. T. Person.

ARNING, LOUIS HENRY, Rock Island, Ill. (Age 27.) Jun. Mechanical Engr., U. S. Engr. Office. Refers to J. H. Childs, F. L. Flynt, J. E. Jewett, R. G. Kasel, H. P. Warren.

BARBER, EDWIN WALLACE, San Francisco, Calif. (Age 30.) Water Purification Engr., Purification Div., San Francisco Water Dept. Refers to G. E. Arnold, A. C. Beyer, F. E. DeMartini, C. G. Hyde.

BEANE, JOHN ARTHUR, Kenmore, N.Y. (Age 33.) With Eng. Dept., R. S. McMannus Steel Constr. Co., Buffalo, N.Y. Refers to E. C. Boehm, C. H. Field, G. J. Mack, S. S. Neff, A. P. Skaer.

BENLINE, ARTHUR JAY, Bronxville, N.Y. (Age 37.) Res. Engr. Inspector, PWA. Refers to G. H. Aspland, R. H. Beattie, L. Fleischmann, M. E. Gilmore, J. D. Moore.

BOGEMA, MARVIN, Chicago, Ill. (Age 26.) Civ. Engr. with Greeley & Hansen, Hydr. and San. Engrs. Refers to A. W. Consoer, S. A. Greeley, P. Hansen, P. A. Smith, R. A. Smith, W. E. Stanley.

BOWRON, CHARLES EDWARD, Birmingham, Ala. (Age 66.) Refers to W. B. Allen, A. C. Decker, A. B. Dunning, E. E. Michaels, A. C. Polk, E. Ramsay, O. G. Thurlow, C. A. Wilmore, W. N. Woodbury.

BOYER, HENRY FRANK, Pittsburgh, Pa. (Age 26.) Jun. Engr., U. S. Engr. Office. Refers to E. P. Schuleen, R. L. E. Ward, J. T. Whitney.

COOKE, CHARLES WALLACE, Hartford, Conn. (Age 47.) Div. Engr. in charge of Planning Div., City of Hartford. Refers to C. J. Bennett, W. J. Ennis, J. T. Henderson, L. F. Peck, R. J. Ross, W. A. D. Wurts.

COOKE, ERNEST EDWARD, York, Pa. (Age 46.) Vice-Pres. and Gen. Mgr., Thomasville Stone & Lime Co. Refers to C. F. Bornefeld, D. A. Decker, F. H. Dryden, G. P. Jones, S. L. Thomsen, J. E. Willoughby, W. A. Young.

CORWIN, HAROLD JAY, Chattanooga, Tenn. (Age 23.) Eng. Aide, Highway and Railroad Div., TVA. Refers to J. K. Finch, A. S. Fry, G. H. Hickox, W. S. Lohr, E. H. Rockwell.

CRABTREE, FREDERICK HOWARD, Medford, Mass. (Age 37.) Asst. Prof. of Civ. Eng., and Asst. Dean, Eng. School, Tufts Coll. Refers to C. L. Bell, H. P. Burden, R. W. Lefavour, C. E. Nichols, F. N. Weaver, E. Wright.

CURTIN, JOHN FRANCIS, New York City. (Age 25.) Refers to E. W. Bowden, G. L. Lucas, D. S. Trowbridge.

DEVENEY, JAMES CAMPBELL, Nahant, Mass. (Age 26.) Job Supt., C. H. Cunningham & Co., Inc., Lynn, Mass. Refers to E. R. Cary, J. J. Hurley, T. R. Lawson, H. O. Sharp.

DOUGLASS, WALTER ALBERT, Sacramento, Calif. (Age 41.) Asst. to Bridge Constr. Engr., State of California, Div. of Highways. Refers to J. Gallagher, L. C. Hollister, I. O. Jahlstrom, A. J. A. Meehan, F. W. Panhorst, A. L. Richardson, H. D. Stover.

ETHRIDGE, FLAVEL DRYDEN, JR., Meridian, Miss.

(Age 24.) Dist. Supervisor of Malaria Control, U. S. Public Health Service, Jackson, Miss. Refers to F. J. Brown, G. R. Clemens, C. P. Lindner, D. M. McCain, N. H. Rector.

Eyster, Lamar Daugherty, Scottsboro, Ala. (Age 39.) Res. Engr., Alabama State Highway Dept. Refers to H. D. Burnum, W. Finnell, L. Gottlieb, H. H. Houk, R. D. Jordan, H. C. Wells.

Fadel, Fadel John, Cleveland, Ohio. (Age 22.) Refers to G. E. Barnes, M. S. Douglas, G. B. Earnest, F. L. Plummer, G. B. Sowers.

Foster, Edward Terrence, Omaha, Nebr. (Age 33.) Supt. of Constr., Omaha Steel Works. Refers to G. P. Dorsey, R. E. Edgecomb, J. Latenser, Jr., J. G. Mason, H. Trustin, K. E. Vogel.

Geyman, Charles Loftus, Oakland, Calif. (Age 32.) Chf. of Party, Joint Highway Dist. No. 13. Refers to N. D. Baker, W. B. Boggs, M. C. Collins, E. H. Frisell, A. S. Gelston, G. S. Harman.

Goodrich, John Emery, St. Louis, Mo. (Age 39.) Engr. with U. S. Div. Engr., Upper Mississippi Valley, Div. Refers to E. L. Daley, M. Elliott, G. W. Francis, A. F. Griffin, J. W. Woermann.

Gould, John Melvin, Piedmont, Calif. (Age 33.) Field Engr., Pacific Gas & Elec. Co., San Francisco, Calif. Refers to C. W. Appleford, F. E. Baxter, Jr., T. J. Corwin, Jr., B. C. Gerwick, I. H. Larsen, O. W. Peterson, I. C. Steele.

Groves, Henry George, Bismarck, N.Dak. (Age 35.) Materials Engr. (directing Materials Laboratory), North Dakota Highway Dept. Refers to S. M. Brown, W. J. Emmons, H. E. Fowler, E. R. Griffin, C. Johnson, W. P. Linton, Z. E. Sevison.

Grow, Wesley Horace, Bountiful, Utah. (Age 37.) Asst. Res. Engr. Inspector, PWA. Refers to E. B. Feldman, R. A. Hart, I. T. Heller, F. M. Keller, H. S. Kerr, G. A. Lyon, J. H. Tempest, K. C. Wright.

Harding, Louis Allen, Buffalo, N.Y. (Age 61.) Pres., Harding-Carlton Corporation, Engrs. and Conrs.; Commr., Dept. of Public Works. Refers to G. B. Bassett, G. W. Carlton, W. T. Huber, E. P. Lupfer, G. S. Minniss, N. Stone, F. K. Wing.

Hayes, Francis Vincent, New York City. (Age 48.) Asst. Sec. Engr., Sixth Ave. Subway, Board of Transportation. Refers to T. M. Brassel, A. E. Clark, B. Houghtaling, C. M. Madden, J. B. Martin, J. H. Myers, R. Ridgway, J. B. Snow.

Heald, Henry Townley, Chicago, Ill. (Age 33.) Dean and Prof. of Civ. Eng., Armour Inst. of Technology. Refers to M. L. Enger, A. Engh, J. R. Griffith, L. E. Grinter, B. S. Nethercut, J. C. Penn.

Henderson, Cornelius Langston, Detroit, Mich. (Age 30.) Designer and Engr., Detroit Memorial Park Association. Refers to C. M. Goodrich, F. C. McMath, L. A. Paddock, W. Pope, R. S. Swinton, J. A. Van den Broek.

Hendrick, Wyatt Burl, Lawton, Okla. (Age 28.) City Engr. Refers to J. F. Brookes, M. C. Burke, L. M. Bush, G. H. James, V. V. Long, N. E. Wolfard.

Hewitt, Charles George, Salem, N.J. (Age 22.) Refers to D. M. Griffith, O. L. King.

James, John Sexton, Helena, Mont. (Age 52.) State Engr. of Montana; Secy. and Engr. of Carey Land Act Board; Consultant, State Water Conservation Board. Refers to C. E. Atwood, C. C. Carey, H. M. Chadwick, D. F. Giboney, H. W. Gregory, C. S. Heidel, W. A. Lamb, W. E. Swift.

Jordan, Lawrence Wilby, Downey, Calif. (Age 52.) Hydrographer, Grade V, Los Angeles County Flood Control Dist. Refers to P. Baumann, B. A. Etcheverry, G. B. Gleason, F. B. Laverty, C. G. Paulsen, A. B. Purton, W. J. Wood.

Kaiser, Harry Andrew, Brooklyn, N.Y. (Age 27.) Draftsman, Eng. Dept., New York Telephone Co. Refers to H. E. Breed, L. V. Carpenter, T. Saville, C. T. Schwarse, E. J. Squire, D. S. Trowbridge.

Kelly, John Joseph, New York City. (Age 52.) Asst. Engr. (Shift Engr.), Board of Transportation, City of New York. Refers to B. J. Ahearn, J. L. Davis, P. P. Farley, C. Gilman, B. Houghtaling, T. F. McQuade, C. M. Madden, A. V. Ruggles, H. D. Winsor.

Kenyon, Edgar Clay, Jr., San Marino, Calif. (Age 36.) Hydraulic Engineer for the Los Angeles County Flood Control Dist. Refers to P. Baumann, K. J. Harrison, H. E. Hedger, N. B. Hodgkinson, F. B. Laverty, F. Thomas, W. J. Wood.

Laender, Ivor Tulk Chesson, Niagara Falls, Ont., Canada. (Age 38.) Res. Engr., Canadian Niagara-Power Co., Ltd. Refers to H. G. Acres, L. S. Bernstein, N. R. Gibson, T. H. Hogg, J. H. Ings.

Learned, Samuel Stanley, Bartlesville, Okla. (Age 35.) Asst. Chf. Engr., Phillips Petroleum Co. Refers to E. B. Black, H. W. Crawford, T. M. Hipp, E. F. Kindsvater, D. A. Leach, W. C. McNown, A. H. Riney.

McGee, James Herman Taylor, Everglades, Fla. (Age 33.) Engr. for Collier Interests. Refers to E. Friedman, M. R. Kays, J. W. Leroux, M. N. Lipp, R. W. Reed, C. E. Swank.

Maierhofer, Charles Richard, Marshall Ford Dam, Tex. (Age 26.) Engr. with U. S. Bureau of Reclamation. Refers to H. P. Bunger, M. J. Miller, C. P. Seger, U. Stephens, H. F. Stubbs.

Moore, Frederic Finbar, Brooklyn, N.Y. (Age 25.) Asst. Constr. Supt. on fireproof apartment house buildings. Refers to M. Grunauer, D. S. Trowbridge.

Munger, Elmer Lewis, Pine Bluff, Ark. (Age 22.) Rodman, Div. Engr.'s Office, St. Louis Southwestern Ry. Refers to L. E. Conrad, R. A. Moyer, C. H. Scholer.

O'Connor, Gerald Alexander, Caracas, Venezuela. (Age 33.) Mgr. of Caracas Office, Raymond Concrete Pile Co. Refers to J. J. Collins, H. P. Hamlin, W. V. McMenimen, J. R. Stubbins, J. W. Taussig, M. M. Upson.

Poole, Blucher Adams, Indianapolis, Ind. (Age 32.) Chf. Engr., State Board of Health, Indiana State Div. of Public Health. Refers to C. B. Carpenter, D. Doggett, F. C. Dugan, H. O. Garman, C. H. Hurd, F. Kellam, W. A. Knapp, G. E. Lommel, J. W. Moore, H. S. Morse, E. D. Rich, L. V. Sheridan, F. H. Waring, R. B. Wiley.

Porter, Alan Anderson, Chicago, Ill. (Age 33.) Asst. Engr., American Bridge Co. Refers to F. W. Dencer, J. R. Fox, H. C. Hunter, I. O. Jahlstrom, A. F. Reichmann, C. E. Webb.

Pou, James Francis, Chattanooga, Tenn. (Age 24.) Asst. Engr. Aide, TVA, acting as Office Asst. to Chf. of Surveys, Maps and Surveys Div. Refers to R. O. Anderson, H. J. Kelly, C. L. Mann, R. L. Moore, G. D. Whitmore.

Prichard, Robert Leo, Decatur, Ga. (Age 26.) Res. Engr., J. B. McCrary Co., being Engr. in charge of construction of municipal improvements (principally PWA). Refers to E. L. Grimes, D. Mills, F. C. Snow.

Purser, George Elliott, San Jose, Calif. (Age 32.) Surveyor with Goldfield Consolidated Mines, San Francisco, Calif. Refers to M. H. Antonacci, A. J. Barclay, C. G. Lewis, F. H. Tibbetts, N. Ware, M. D. Williams, H. I. Wood.

Raymond, Fay Marshall, Springfield, Mo. (Age 41.) Cons. Engr. Refers to T. R. Agg, C. E. Boesch, R. W. Crum, M. B. Morris, H. N. Ogden, S. M. Rudder, J. W. Woermann.

Richardson, Louis Alexander, State College, Pa. (Age 33.) Asst. Prof. of Arch. Eng., Dept. of Architecture, Pennsylvania State Coll. Refers to J. L. Cherry, C. L. Harris, F. G. Jonah, C. E. Palmer, R. L. Sackett, H. R. Thayer.

Roberts, Wesley, San Benito, Tex. (Age 32.) Eng. Draftsman, U. S. Dept. of State, International Boundary Comm. Refers to W. W. Hall, J. L. Lytel, A. J. Moore, J. M. Phillips, A. Tamm.

Rodhouse, Thomas Jacob, Jr., Rock Island, Ill. (Age 29.) Asst. Engr., Lands Sec., U. S. Engr. Office, Rock Island, Ill. Refers to O. G. Baxter, J. E. Jewett, E. M. Kniestedt, H. Rubey, H. P. Warren.

Rowland, William Joseph, Vicksburg, Miss. (Age 35.) Tech. Asst. to Chf. of Soils Sec., U. S. Waterways Experiment Station. Refers to W. L. Benham, S. J. Buchanan, M. C. Burke, G. R. Clemens, G. H. Matthes, H. W. Nighswonger.

Shaffer, Walter John, Jefferson City, Mo. (Age 40.) Final Plans Engr., Missouri State Highway Dept. Refers to R. W. Brooks, C. W. Brown, M. J. Burke, J. R. Ellis, C. V. Mann, E. C. L. Wagner.

Smith, Richard Bennett, Detroit, Mich. (Age 49.) Structural Designer, The Panama Canal, Sec. of Office Engr., Balboa Heights, Canal Zone. Refers to P. Andersen, J. T. N. Hoyt, R. C. Kellogg, O. H. S. Koch, A. N. Outzen, F. E. Powell.

Solem, Erik Johannes, Long Beach, Calif. (Age 35.) With J. H. Davis, Cons. Engr., as Supt. on Proctor & Gamble's Long Beach extension ($1,000,000). Refers to A. H. Adams, C. L. A. Bockemohle, J. A. A. Brodahl, A. L. Ferver, M. Graham, Jr., C. Johnson, C. D. Wailes, Jr.

Sporn, Philip, Brooklyn, N.Y. (Age 41.) Vice-Pres. and Chf. Engr., American Gas & Elec. Co., New York City. Refers to J. W. Barker, H. J. Deutschbein, N. I. Kass, C. S. Landers, H. S. Slocum, W. M. White.

Stribling, Ralph Copeland, Kilgore, Tex. (Age 37.) Dist. Engr., Gulf Oil Corporation, Houston, Tex. Refers to W. A. Blakemore, B. S. Gentry, G. H. Lacy, J. T. L. McNew, W. H. Mead, W. P. Stine.

Sutherland, Reginald Joseph, New York City. (Age 26.) Tech. Asst., Bell Telephone Laboratories. Refers to L. V. Carpenter, C. T. Schwarze, D. S. Trowbridge.

Treece, Clyde Charles, New Orleans, La. (Age 29.) Engr., Phoenix Eng. Corporation. Refers to J. R. Rhyne, W. R. Spencer.

van de Erve, Jerome, Davenport, Iowa. (Age 28.) Asst. to Supervisor of Hydrologic Work, U. S. Weather Bureau. Refers to D. H. Barber, B. S. Barnes, R. G. Kasel, C. E. McCashin.

Webster, Willard Wright, Bismarck, N.Dak. (Age 26.) Rodman, North Dakota State Water Conservation Comm. Refers to C. Johnson, C. E. Mannerow, J. J. Walsh.

Weldy, Raymond Nicholas, Eldon, Mo. (Age 31.) Asst. Hydr. Engr., Union Elec. Co. of Missouri. Refers to H. C. Beckman, A. Davis, W. S. Frame, F. T. Mavis, E. A. Rudulph, S. M. Woodward.

Wheeler, William Thornton, Pasadena, Calif. (Age 26.) Senior Structural Draftsman, Los Angeles Union Passenger Terminal. Refers to R. W. Allin, C. L. A. Bockemohle, R. R. Martel, W. W. Michael, V. L. Peugh, F. Thomas.

Wilcox, Harry Earle, Edinburg, Tex. (Age 48.) Civ. Engr. Refers to H. B. Christianson, F. F. Friend, C. A. Hoglund, H. H. Kidder, J. L. Nagle, W. D. Pence, J. W. Shikles.

Wilkes, Kenneth George Harold, Leevining, Calif. (Age 26.) Jun. Civ. Engr., Dept. of Water & Power, Los Angeles, Calif., Mono Basin Project. Refers to E. A. Bayley, H. P. Bliss, C. Derleth, Jr., B. A. Etcheverry, S. T. Harding, D. A. Lane, W. W. Wyckoff.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

Beavin, Benjamin Everett, Assoc. M., Annapolis, Md. (Elected Jan. 29, 1934.) (Age 35.) Secy.-Treas. of Annapolis Metropolitan Sewerage Comm.; also Sales Mgr., Annapolis Dairy Products Co. Refers to R. L. Burwell, F. H. Dryden, H. R. Hall, G. J. Requardt, A. Wolman.

Caiola, Fred, Assoc. M., New York City. (Elected Oct. 26, 1931.) (Age 47.) Asst. Engr., Board of Transportation. Refers to A. F. Callahan, A. K. Johnson, W. K. Peasley, J. C. Riedel, I. J. Stander.

Chobot, Edwin Frank, Assoc. M., Chattanooga, Tenn. (Elected Oct. 10, 1927.) (Age 37.) Sales Mgr., Converse Bridge & Steel Co. (designers, fabricators, and erectors of structural steel). Refers to F. A. Barnes, O. J. Miller, J. E. Morelock, A. F. Porzelius, W. H. Sears, D. H. Wood.

Dick, Albert, Assoc. M., New York City. (Elected Junior Jan. 17, 1921; Assoc. M. Jan. 14, 1929.) (Age 41). Asst. and Acting Sec. Engr., Div. of Design, Borough of Manhattan Elevated Public Highway. Refers to C. K. Conard, J. Friedland, J. Goodman, C. M. Pinckney, P. Quilty, J. C. Riedel, B. Schwerin.

Flagg, Herbert Judson, Assoc. M., Newark, N.J. (Elected Junior Oct. 3, 1911; Assoc. M. April 19, 1920.) (Age 49.) Chf. Engr., New Jersey Board of Public Utility Commrs. Refers to C. E. Beam, F. Blossom, H. L. Gray, V. H. Hewes, C. A. Mead, W. C. Morse, J. C. Stevens.

Glassett, Alfred Thomas, Assoc. M., New York City. (Elected April 15, 1929.) (Age 37.) Director and Vice-Pres., W. J. Barney Corporation. Refers to W. J. Barney, C. B. Breed, J. K. Campbell, F. LeR. Francisco, H. Manley, Jr., E. E. Seelye.

McLean, Cecil John, Assoc. M., Dixon, Ill. (Elected Dec. 14, 1925.) (Age 40.) Hydr. and Constr. Engr., Illinois Northern Utilities Co. Refers to C. L. Allen, H. E. Babbitt, C. M.

Cade, T. W. Clayton, O. L. Gearhart, R. K. Holland, R. W. Putnam.

MANES, COLE, Assoc. M., Dallas, Tex. (Elected March 11, 1935.) (Age 37.) City Engr., City of University Park, Dallas County, Tex. Refers to E. C. H. Bantel, F. F. Bell, G. W. Gill, W. H. Meier, E. N. Noyes, W. J. Powell.

MAYNARD, ROBERT LEE, Assoc. M., Asheville, N.C. (Elected July 27, 1931.) (Age 38.) City Engr. (in charge of Eng. Dept. and Bldg. Inspection Dept.). Refers to E. D. Burchard, E. L. Hageman, H. E. Howes, R. J. Rosenberger, C. E. Waddell.

STICKNEY, EDWARD ELIAS, Assoc. M., Binghamton, N.Y. (Elected Aug. 27, 1928.) (Age 48.) Superintending Engr., New York State Dept. of Public Works, Div. of Highways, Dist. No. 9. Refers to R. G. Finch, C. T. Fisher, H. C. Hill, E. H. Prentice, H. O. Schermerhorn, E. W. Wendell.

TRUSS, FELIX WARNER, Assoc. M., Paris, Tenn. (Elected March 5, 1928.) (Age 42.) With TVA. Refers to H. W. English, A. S. Fry, L. L. Hidinger, H. V. Pittman, N. H. Sayford, W. G. Stromquist, H. A. Wiersema.

WHITCOMB, LOUIS KOSSUTH, JR., Assoc. M., Pittsburgh, Pa. (Elected Junior Jan. 15, 1923; Assoc. M. Oct. 1, 1926.) (Age 36.) With Carnegie-Illinois Steel Corporation. Refers to F. L. Gorman, W. L. Havens, J. M. Heffelfinger, Jr., R. P. Pennoyer, H. G. Roby, M. C. Tyler, W. J. Watson.

FROM THE GRADE OF JUNIOR

BAIRD, GORDON GIFFORD, Jun., Clinton, N.Y. (Elected May 23, 1932.) (Age 32.) Asst. Engr., Grade 1, Oneida County Dept. of Highways, Utica, N.Y. Refers to L. D. Brownell, R. M. Kelly, E. W. Kurz, O. F. Lewis, D. A. McClung, H. V. Owens.

BALL, JAMES WESLEY, Jun., Fort Collins, Colo. (Elected April 22, 1935.) (Age 32.) Asst. Engr., U. S. Bureau of Reclamation, in charge of Hydr. Laboratory, Colorado State Coll. Refers to J. N. Bradley, E. W. Lane, R. L. Parshall, C. Rohwer, J. L. Savage, J. E. Warnock.

BARKER, CHARLES LOVE, Jun., Pullman, Wash. (Elected March 11, 1929.) (Age 32.) Asst. Prof. of Hydr. Eng., State Coll. of Washington. Refers to F. Bass, A. S. Cutler, G. H. Dunstan, O. M. Leland, E. E. Moots, L. G. Straub, C. C. Williams.

BRANSFORD, HOWELL ALEXANDER, JR., Jun., Jackson, Tenn. (Elected Dec. 22, 1930). (Age 31.) Field Engr. Service Bureau, Penn-Dixie Cement Corporation. Refers to H. T. Ammerman, R. H. Baker, E. W. Bauman, R. P. Black, T. L. Bransford, F. C. Snow.

BRIAN, LAWRENCE GORDON, Jun., Berkeley, Calif. (Elected Oct. 1, 1928.) (Age 32.) Designer and Checker, Standard Oil Co., San Francisco, Calif. Refers to G. H. Elbin, F. C. Fox, Jr., K. F. Mundt, L. B. Reynolds, A. R. Webb, S. K. Whipple.

CLARKE, JOHN WHITE, Jun., Guntersville Dam, Ala. (Elected Dec. 5, 1927.) (Age 32.) Field Engr., TVA. Refers to C. C. Cullum, V. Gongwer, J. S. Kennoy, G. K. Leonard, B. S. Philbrick, T. W. Proctor.

DHILLON, ARJAN SINGH, Jun., New Delhi, India. (Elected April 25, 1932.) (Age 30.) Asst. State Engr., Farid Kot State Public Works Dept. Refers to J. H. Cissel, L. M. Gram, H. W. King, R. L. Morrison, R. H. Sherlock, K. Singh, J. S. Worley.

DUCHARME, JEAN MARC, Jun., Boston, Mass. (Elected Oct. 26, 1931.) (Age 27.) Asst. Engr., Bridges and Buildings, J. R. Worcester & Co., Cons. Engrs., acting as Bridge and Bldg. Surveyor, Designer and Constr. Inspector. Refers to L. F. Ellis, J. C. Moses, E. A. Norwood, G. Small, J. R. Worcester.

FENTON, ELY GRAY, Jun., Pittsburgh, Pa. (Elected May 12, 1930.) (Age 32.) Asst. Engr. (Civil), U. S. Engr. Dept.-at-Large, U. S. Army. Refers to W. E. R. Covell, W. H. Critser, F. J. Fitzpatrick, C. T. Morris, C. E. Sherman.

FISCEL, LOUIS O'NIEL, Jun., Florence, Ariz. (Elected Dec. 28, 1931.) (Age 32.) County Engr., Pinal County Highway Dept. Refers to W. H. Becker, E. S. Borgquist, F. C. Kelton, E. V. Miller, J. C. Park, J. W. Powers.

HAMMOND, HAROLD FRANCIS, Jun., New York City. (Elected Feb. 24, 1931.) (Age 29.) Director, Traffic Div. National Conservation Bureau. Refers to E. P. Goodrich, B. D. Greenshields, A. Haertlein, R. L. Morrison, L. F. Rader, J. S. Worley.

LENNEN, WILLIAM ELLIOTT, Jun., Banning, Calif. (Elected Oct. 29, 1934.) (Age 30.) Constr. Foreman, High Grade (Night Walker), Metropolitan Water Dist. of Southern California. Refers to W. R. Armstrong, G. E. Baker, J. B. Bond, R. B. Diemer, B. A. Eddy, H. G. Matthews, N. B. Smith.

MCNEIL, DONALD MILLER, Jun., Pittsburgh, Pa. (Elected Jan. 17, 1927.) (Age 32.) Traffic Engr., City of Pittsburgh, Bureau of Traffic Planning, DPS. Refers to L. P. Blum, S. Eckels, H. D. Johnson, Jr., L. C. McCandliss, B. W. Marsh, J. M. Rice, N. Schein.

MATTERN, DONALD HECKMAN, Jun., Knoxville, Tenn. (Elected Oct. 1, 1926.) (Age 32.) Asst. to J. F. Roberts, Design Dept., TVA. Refers to J. P. Blundon, H. L. Fruend, F. Kerekes, C. E. Pearce, G. R. Rich, R. M. Riegel, E. D. Walker.

MERRITT, WILL DOCKERY, Jun., Mount Airy, N.C. (Elected Oct. 1, 1928.) (Age 32.) City Engr. and Supt. of City Water Dept. Refers to D. S. Abell, H. G. Baity, T. F. Hickerson, H. F. Janda, R. M. Trimble.

NELSON, FRANK KJELD, Jun., Babylon, N.Y. (Elected Oct. 14, 1929.) (Age 32.) Senior Draftsman, New York State Highway Dept. Refers to F. L. Bixby, H. P. Boardman, G. F. Cant, Jr., W. H. Latham, R. P. Lent, S. Shapiro.

NEWBERRY, RAGAN MCGREGOR, Jun., Neodesha, Kans. (Elected Dec. 14, 1936.) (Age 30.) With City of Neodesha. Refers to J. W. Ivy, R. E. Lawrence, G. M. March, F. M. Veatch, N. T. Veatch, Jr.

NICKLE, HARRY GORDON, Jun., Austin, Tex. (Elected Oct. 1, 1926.) (Age 32.) Asst. Irrigation Engr., Div. of Irrigation, Bureau of Agricultural Eng., U. S. Dept. of Agriculture. Refers to H. F. Blaney, C. S. Clark, C. E. Ellsworth, J. W. Pritchett, C. A. Taylor.

PERRY, ANTHONY JOHN, Jun., Denver, Colo. (Elected Oct. 14, 1929.) (Age 32.) Asst. Engr., U. S. Bureau of Reclamation. Refers to H. H. Bennet, J. N. Bradley, F. B. Cook, Jr., D. J. Hunt, W. H. Nalder, R. D. Welsh.

TORIBIO, SIMEON GALVEZ, Jun., Manila, Philippine Islands. (Elected Feb. 19, 1934.) (Age 32.) Res. Engr., Rizal Memorial Field, Philippine Amateur Athletic Federation, Manila; also Prof., Mapua Inst. of Technology, Manila. Refers to O. A. Boni, R. M. Fox, S. Garmezy, C. Russell, D. M. Wilson.

WARREN, FREDERICK HAYES, Jun., Washington, D.C. (Elected Dec. 14, 1936.) (Age 27.) Eng. Examiner, RFC. Refers to G. E. Beggs, F. H. Constant, W. L. Drager, J. A. Fraps, W. W. Lane, R. V. Leeson, M. Macartney.

WILLIAMS, ROBERT EMIL, Jun., Grovetown, Ga. (Elected July 16, 1928.) (Age 32.) Engr., Production Dept., The Cocoa-Cola Co., Bottling Administrative Div., Wilmington, Del. Refers to R. P. Black, T. J. Durrett, Jr., R. V. Glenn, R. L. MacDougall, M. T. Singleton, F. C. Snow.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 87 of the 1937 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

CONSTRUCTION

CIVIL OR CONSTRUCTION ENGINEER; Jun. Am. Soc. C.E.; George Washington University; married; 11 years experience in general construction, hydraulic structures, and office engineering. Executive experience. Knowledge of photography (including aerial) and flying. Desires permanent connection in the South, preferably Florida or Louisiana. Available at once. C-216.

CIVIL ENGINEERING GRADUATE; Jun. Am. Soc. C.E.; with 7 years experience in surveying and building construction wishes position in building construction field. Location, New York or vicinity preferred. C-212.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 32; married; B.S.C.E., Purdue University; 1 year postgraduate work, Chicago University; 3 years engineer on building construction; 1 year concrete tunnel inspection, Fort Peck Dam; 2¹/₂ years geodetic, topographic, and hydrographic engineering connection with aero-photographic surveys and maps. Location immaterial; employed; available on reasonable notice. C-225.

DESIGN

DESIGNER, STEEL OR CONCRETE; Assoc. M. Am. Soc. C.E.; 11 years experience, office and field work, on subways, buildings, power plants, and heavy foundations. Licensed in New York and New Jersey; can take charge of office or field. C-210.

EXECUTIVE

CONTRACTOR-ENGINEER-ESTIMATOR; Assoc. M. Am. Soc. C.E.; Am. Chem. Soc. Industrial, metallurgical (lead and zinc), chemical, and oil and gas field plants—plate, tank, structural, and special equipment for processing plants. Contracting and sales representative. C-211.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 47; married; graduate mining engineer; registered civil engineer in California; 20 years experience, business, municipal, and governmental positions. Experienced in field work, drafting, land office procedure, procuring of lands and rights of way, handling correspondence and record systems. Desires position of responsibility or as assistant to executive. C-219.

CIVIL GRADUATE; Jun. Am. Soc. C.E.; 15 years broad experience, design, construction, and research. Desires position of responsibility requiring, besides sound engineering judgment and ability, hard work, long hours, and a keen and tactful executive with a tenacity to get the job done and done right. Engaged, but available on short notice. C-222.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 39; single; last 6 years in charge of movable bridge designs for largest Eastern railroad. Previous experience on toll bridges, office buildings, rail terminals, aeroplane hangar, waterway structure design; oscillograph bridge stress investigations; highway, sewer, paving construction; also organizing and administrative experience. Available immediately. West Coast preferred. C-226-3412-A-2 San Francisco.

BRIDGE ENGINEER; M. Am. Soc. C.E., with many years experience in the design, construction, and maintenance of all types of fixed and movable bridges, viaducts, and street improvements. Prefers Chicago or vicinity. C-220.

ENGINEER-EXECUTIVE OR ASSISTANT; M. Am. Soc. C.E.; licensed, New York and New

Jersey. Structural training; long experience as engineer in charge of development and design of industrial plants, railroad shops, warehouses, and engineering structures. Also appraisals and reports. Previously with large firm of engineers and constructors doing work throughout United States and South America. C-224.

Civil Engineer; Assoc. M. Am. Soc. C.E.; B.S.; postgraduate, sciences; 34; married; registered surveyor, Pennsylvania; 3 years chief of party, highways; field and office, large earth dam construction; 1 year construction foreman, highways; $1^1/_2$ years engineer, ECW; $1^1/_2$ years in charge of drafting room, designs small earth dam and underground utilities, land surveys. Available immediately. C-236.

Civil and Sanitary Engineer; Assoc. M. Am. Soc. C.E.; 39; married; graduate of Massachusetts Institute of Technology; 16 years experience with engineering firm on water works, drainage, sewerage, sewage treatment, and valuations. Can take charge of investigations, reports, designs, preparation of construction drawings. Location, United States. Employed but available soon. C-229.

Water Works Manager and Engineer; M. Am. Soc. C.E.; Member Am. W. W. Assn.; registered engineer and surveyor in Ohio; 30 years general municipal engineering, including 10 years as chief engineer and construction superintendent for city of 200,000; extension and improvements totaling $3,000,000; 14 engineers, 200 direct labor. C-228

Civil Engineer; Assoc. M. Am. Soc. C.E.; B.S.C.E., University of Illinois; Illinois structural license; 15 years in charge of design and construction of railroad terminal, water supply and treatment, sewage treatment, building construction and contracting, operation and maintenance, surveys of water resources, power houses. Available immediately. C-234.

Civil Engineer; Jun. Am. Soc. C.E.; 33; B.S., Massachusetts Institute of Technology, 1926; 4 years in responsible charge of building and operating group of C.C.C. camps, as captain engineer-reserve; $1^1/_2$ years as executive for motor freight concern; $3^1/_2$ years experience in structural design, principally reinforced concrete buildings. Knowledge of Spanish. Interested in permanent position in United States, preferably in vicinity of Philadelphia. C-233.

Junior

Sanitary Civil Engineer; Jun. Am. Soc. C.E.; 27; single; B.S.C.E.; varied and successful experience in water treatment and supply, chief in charge of construction of filtration plants, maintenance and operation, and distribution systems. Also experience in highway construction, surveys, mapping. Desires position inside or out, location anywhere. Start with small salary. Available immediately. C-213.

Civil Engineer: Jun. Am. Soc. C.E.; 22; single; B.E. in C.E., the Johns Hopkins University, June 1937; fine scholastic record; desires opportunity in any branch of civil engineering, preferably sanitary engineering. C-214.

Civil Engineer; Jun. Am. Soc. C.E.; 23; single; ScB. in engineering, Brown University, 1936. Had 13 months experience on surface and tunnel survey, 3 months drafting for consulting engineer on water supply. Desires experience in sanitary engineering or construction work. Will travel anywhere. Available on short notice. C-215.

Civil Engineer; Jun. Am. Soc. C.E.; 25; graduate of Massachusetts Institute of Technology; 1 year experience in structural design; 10 months with survey party on city street and building work; 3 years as assistant to project engineer in office. Desires position offering experience, not necessarily in line with past work. Willing to travel. C-218.

Civil Engineer; Jun. Am. Soc. C.E.; 26; single; B.S. in C.E., University of Pittsburgh; 2 years experience in steel mill construction. Desires position with future, not necessarily in construction. Location not important. Available immediately. C-221.

Civil Engineer; Jun. Am. Soc. C.E.; 27; single; B.S.C.E., Massachusetts Institute of Technology; special study of hydroelectric engineering and hydraulics; 3 years varied experience, triangulation, planimetric aerial mapping, soils mechanics, state planning and report writing, hydraulics and river engineering. Desires permanent position that will afford further training in hydraulics or related fields; location immaterial. Excellent recommendations. C-223.

Civil Engineer; Jun. Am. Soc. C.E.; 23; B.S.C.E., New York University, 1936. Over one years experience on large metropolitan housing project as instrumentman. Some experience in estimating, inspection, and drafting. Knowledge of Spanish and German. Desires permanent connection, with future. C-227.

Civil Engineer; Jun. Am. Soc. C.E.; 26; single; B.S.C.E.; $1^1/_2$ years oil industry, transportation-management, and maintenance; 1 year as draftsman and surveyor, public. Seeking job with valuable experience, oil industry or construction work preferable. Location immaterial; available two weeks. C-230.

Civil Engineer; Jun. Am. Soc. C.E.; 26; single; B.S.C.E., University of New Hampshire, 1933; $2^1/_2$ years responsible bridge designing and drafting; 1 year general railway engineering; 1 year construction. Employed at present; available short notice; location immaterial. C-231.

Civil Engineer; Jun. Am. Soc. C.E.; 21; B.S. in engineering, Manhattan College, 1937; high scholastic ability and capable of assuming leadership and responsibility; has had experience in teaching and as a draftsman; desires position as junior engineer with engineering firm, with opportunity for advancement; interested in research. Available immediately. C-235.

Civil Engineer; Jun. Am. Soc. C.E.; 26; B.C.E., Polytechnic Institute of Brooklyn, 1932; candidate for M.C.E., majoring in structural engineering; one year with U. S. Coast and Geodetic Survey as computer; $1^1/_2$ years estimating, report work, surveying on sewer repairs; 8 months as steel designer and estimator with steel contractor. Desires steel designing or estimating. C-232.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 77 of the Year Book for 1937. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

Applied Photogrammetry. By R. O. Anderson. Ann Arbor (Mich), Edwards Brothers, 1937. 120 pp., illus., diagrs., charts, tables, 9 × 6 in., paper, $2.

This manual gives methods for determining the correct scales of aerial photographs, together with an analytical radial-line method of control, taking into account both relief and tilt. It aims to facilitate the simple, practical, and accurate application of aerial photography to various types of surveys.

Eidg. Materialprüfungsanstalt an der E.T.H. in Zürich, Switz. Bericht Nr. 103. Oct. 1936. Beitrag zur Untersuchung der Fachwerke aus Geschweisstem Stahl und Eisenbeton unter Statischen und Dauerbeanspruchungen, by S. A. Mortada. 98 pp., illus., diagrs., charts, tables, 12 × 8 in., paper, apply.

An extensive experimental investigation of the behavior of welded steel and reinforced-concrete girders under static and fatigue strains is described in this volume. The theoretical principles are described, and the methods of testing and results are discussed. The conclusions are summarized in French, Italian, and English.

Construction and Use of Tax Maps. Published by the Public Administration Service (850 East 58th Street), Chicago, Ill., 1937. 51 pp., maps, tables, diagrs., paper, 50 cents.

Assessors who are operating without tax maps or who find their present tax maps inadequate will find this pamphlet invaluable as a guide in map preparation and use. Extensive consideration is given to existing base maps, and a short section is devoted to the mechanics of original surveys both by the traditional method and the newer method of aerial photography.

Differentialgeometrie, Vol. 1. Raumkurven und Anfänge der Flächentheorie. (Sammlung Göschen Nr. 1113.) By R. Rothe. Berlin and Leipzig, Walter de Gruyter & Co., 1937. 132 pp., diagrs., tables, 6 × 4 in., cloth, 1.62 rm.

Space curves and the origins of surface theory are the subjects of this first volume of a series on differential geometry. Material covered includes the analytical construction of space curves and surfaces, tangents, warped surfaces, differential invariants, line elements, cutting angles, and various basic equations.

Eidgenössische Materialprüfungs- und Versuch sanstalt für Industrie, Bauwesen und Gewerbe Zürich, Switzerland. Diskussionsbericht Nr. 111, August 1937. Die Dachziegel aus Gebranntem Ton der Schweizerischen Ziegelindustrie, by P. Haller. 78 pp., illus., diagrs., charts, tables, 12 × 8 in., paper, apply.

Tests on clay roofing tiles from Swiss tile works are discussed. These tests, determining frost resistance, permeability, chipping and similar factors, have been carried out to determine the actual quality of the products of the Swiss tile industry and also to establish new standards, specifications, and test methods for the industry.

Ground Water. New York and London, McGraw-Hill Book Company, 1937. 593 pp., diagrs., charts, tables, 9 × 6 in., cloth, $6.

This book records the development of a new science—coordinated scientific data regarding the occurrence, motions, and activities of subsurface water, and the hydrologic properties of water-bearing materials. This is the first general treatise on the science published in English, and the only one to give a summary of the results of the intensive study of subsurface water in the western part of the United States.

Hermann Recknagels Kalender für Gesundheits- und Wärme-Technik. Edited by K. Gehrenbeck and E. Sprenger. 40. Jahrgang 1938. Munich and Berlin, R. Oldenbourg, 1938. 341 pp., diagrs., charts, tables, 7 × 5 in., cloth, 4.50 rm.

A handbook for sanitary, heating, and ventilating engineers, containing numerical data and information upon design and installation. Heating, ventilating and air conditioning, water supply, drainage, baths, laundries, kitchens, disinfection, and sterilizing are discussed.

Highway Spirals, Banking and Vertical Curves. By H. Criswell, with a foreword by Sir C. Bressey. London, Carriers Publishing Co.; New York, Engineers Book Shop, 1937. 166 pp., diagrs., charts, tables, 9 × 5 in., leather, $2.

This collection of articles and papers, written by the author at various times, is designed as a field book to decrease the amount of calculation in designing highway curves. Part I gives diagrams, tables, and examples for use in plotting and setting out spiral transition curves. Parts II and III cover the computation and design of vertical curves.

Manual on Research and Reports by the Committee on Research of the Amos Tuck School of Administration and Finance, Dartmouth College. New York and London, McGraw-Hill Book Co., 1937. 140 pp., 8 × 5 in., cloth, $1.25.

Wise advice upon the preliminary procedure and mechanics of investigating a subject and on some of the important standards to be observed in presenting the findings are given in this little manual. Writers of theses and research reports will find the book helpful.

CURRENT PERIODICAL LITERATURE

Abstracts of Articles on Civil Engineering Subjects from Magazines in This Country and in Foreign Lands

Selected items from the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the Library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the article from your own file, from your local library, or direct from the publisher. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page, plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

Concrete Arch, Persia. Le chemin de fer Transiranien. Le viaduc en maconnerie de l'Ab-i-Diz, R. Walther. *Genie Civil*, vol. 111, no. 2877, Oct. 2, 1937, pp. 281–4. General information on trans-Iranian railroad between Persian Gulf and Caspian Sea; report on design and construction of Ab-i-Diz single-track concrete-arch bridge, consisting of 9 arches of 10-m clear span and of one main arch of 60-m clear span; ingenious methods of erecting main arch centering.

Concrete Arch, Soviet Union. Die Chimkibruecke fuer vier Eisenbahngleise bei Moskau, P. Kandaouroff. *Beton u Eisen*, vol. 36, no. 6, Mar. 20, 1937, pp. 110–111. Design and construction of Khimki concrete-arch bridge, 100-m net span, carrying four railroad tracks of Moscow-Leningrad line over Moscow-Volga Canal.

Design. New German Bridges, G. Schaper. *Welding J.* (N.Y.), vol. 16, no. 9, September, 1937, pp. 32–39. German practice discussed under heads of welding, shrinkage stresses, flanges for plate girders, welding aids, advantages of welding, welded rigid frames, and Ruegendamm Bridge, dimensional sketches given.

Highway, Connecticut. Bridges on Merritt Parkway, L. G. Sumner. *Eng. News-Rec.*, vol. 118, no. 13, Sept. 23, 1937, pp. 501–506. Typical features of 70 bridges along new 38-mile parkway paralleling Boston Post Road in Fairfield County, Conn.; parkway plan and financing; roadway dimensions; design fundamentals; progress to date; costs.

Masonry Arch. Old Waterloo Bridge: Schemes for Reconditioning and Widening, R. P. Mears. *Structural Engr.*, vol. 15, no. 10, October 1937, pp. 410–417. Discussion of paper before Instn. Structural Engrs., previously indexed from April 1937 issue.

Rigid Frame, Cincinnati, Ohio. Rigid Frame with Vierendeel Bracing, H. H. Kranz. *Eng. News-Rec.*, vol. 119, no. 16, Oct. 14, 1937, pp. 627–629. Design and construction of new McMillan St. Bridge in Cincinnati, composed of four steel ribs of 117-ft main span and 50-ft cantilever side spans, braced apart with open-web Vierendeel cross frames; hinge and leg details of rigid-frame ribs.

Steel Truss, Germany. Die Autobahnbruecke ueber das Werratal bei Hann.-Muenden, I. Zillinger. *Bauingenieur*, vol. 18, nos. 23/24, June 18, 1937, pp. 319–333. Design and construction of new steel-truss viaduct, 532 m long, maximum span 96 m, carrying superhighway across Werra Valley, near Muenden, Germany; layout of construction camp; construction of bridge pier foundations by pneumatic caisson method; structural details of steelwork.

Suspension. Modern Suspension Bridges, S. McConnel. *Civ. Eng.* (London), vol. 32, no. 370, August 1937, pp. 131–133. Review of modern European and American practice; design and construction of suspension bridges; inclined suspenders; improvement in wire ropes; plate girders as stiffening girders; high steel towers; continuous and hinged stiffening girders; economy in construction.

Suspension, France. Developments in Suspension Bridges, G. Leinekugel le Coq. *Civ. Eng.* (London), vol. 32, no. 370, April 1937, p. 122. Design and construction of new stiffened suspension bridges at Mornay-sur-Allier, France. English translation of article, previously indexed from *Génie Civil*, Jan. 2, 1937.

CITY AND REGIONAL PLANNING

Town Planning. Town Planning Requires Engineers, H. A. Shauffler. *Eng. News-Rec.*, vol. 119, no. 14, Sept. 30, 1937, pp. 562–564. Civil engineering aspects of city planning; preliminary surveys; sewerage facilities; water-distribution details; house-location problems.

Zoning. Twenty Years of Zoning, H. Bartholomew. *Eng. News-Rec.*, vol. 119, no. 14, Sept. 30, 1937, pp. 549–553. Appraisal of benefits and shortcomings of zoning, explaining why it has enjoyed its greatest success in small cities.

CONCRETE

Disintegration. How Permanent Is Concrete? *Ry. Age*, vol. 103, no. 12, Sept. 18, 1937, pp. 367–373. Seven railway engineers express their views on cement as factor in failure or deterioration of structures.

Floors. Test of Pre-Cast Concrete Floor Units, A. F. Holmes and H. G. Protze, Jr. *Eng. News-Rec.*, vol. 119, no. 13, Sept. 23, 1937, pp. 507–508. Results of tests made at Massachusetts Institute of Technology, yielding new data on shear resistance, strength, and absorption of blocks used in so-called unit-and-joist floor system; load-deformation diagram for 6 by 12-in; cylinders of four different kinds of concrete; typical shear failure in specimen consisting of pre-cast units with poured concrete ribs on both sides.

Forms. Early Hung Form for Concrete Floors, E. E. Howard. *Eng. News-Rec.*, vol. 119, no. 15, Oct. 7, 1937, p. 609. Description of hung suspended forms used in building Sixth St. Viaduct at Kansas City, Mo.

Towers, Construction. Cast Stone Facing Functions as Outside Form for Concrete Walls of Tall Shaft. *Construction Methods & Equipment*, vol. 19, no. 3, March 1937, pp. 46–48. Construction of 215-ft high reinforced concrete Nemours Carillon Tower near Wilmington, Del.; cast stone facing served as outside form for monolithic wall concrete placed in 4-ft lifts behind individual stone courses; erection procedure; quantities and equipment.

DAMS

Boulder Dam, Spillways. Automatic Sector Sluice Spillways at Boulder Dam, P. A. Kinzie. *Engineering*, vol. 144, nos. 3731 and 3733, July 16, 1937, pp. 61–62, and July 30, pp. 113–115, supp. plates. Illustrated description of spillways; four sector gates, 100 ft long, having effective height of 16 ft, are provided in each spillway, to hold level of reservoir automatically 24 ft above fixed crest level.

Concrete Gravity, Failure. Failure of Gravity Dams, N. Kelen. *Engineering*, vol. 144, nos. 3736 and 3737, Aug 20, 1937, pp. 215–217, and Aug. 27, pp. 242–243. Summary, based on translation by S. Shulits, of report entitled, "Experimental Determination of Tangential Foundation Resistance of Gravity Dams," describing experiments conducted at Prussian Experimental Institute for Hydraulic Engineering and Naval Architecture, Berlin.

Concrete Gravity, New Zealand. Notes on Design of Waitaki Dam, G. P. Anderson. *New Zealand Soc. Civ. Engrs.—Proc.*, vol. 23, 1936–1937, pp. 95–111, (discussion) 112–122, supp. plate. Design and construction of curved concrete gravity overflow dam 122 ft high, 1,713 ft long, spilling capacity over 200,000 cu ft per sec.

Earth, Failure. WPA Dam Fails at Kansas City. *Eng. News-Rec.*, vol. 119, no. 13, Sept. 23, 1937, p. 495. Failure on Sept. 20, 1937, of Wyandotte County Lake earthfill dam near Kansas City, planned to be 84 ft high and 1,550 ft long; theory of foundation failure.

Power Plants, United States and Canada. World Power Conference Trans-Continental Tour *Engineer*, vol. 163, nos. 4246, 4247, and 4248, May 28, 1937, pp. 612–614; June 4, pp. 640–643 and 645; and June 11, pp. 666–669 and 676. Illustrated account of study tours in connection with Third Power Conference, in which number of major projects throughout United States and Canada were visited; tour began in New York, proceeded to Canada, then went across United States to Seattle, with short stop in Chicago and visits to three large dams en route.

Regulation of Streams. Die Regelung kleinerer Wasserlaeufe durch Errichtung von Gefaellstufen, C. Keutner. *Bautechnik*, vol. 15, nos. 13/14, Mar. 26, 1937, pp. 173–188. Improvement of small streams in mountainous country by construction of check dams and regulation of channels; hydraulics of torrential streams; lining and revetment of banks; design and construction of check dams.

Reservoirs, Concrete. Remarkable Reservoir. *Engineer*, vol. 164, no. 4260, Sept. 3, 1937, p. 263. Brief illustrated description of water reservoir at Nantes, France, which is 3-storied with capacity of 8,800,000 gal; consists of series of thin arched sections in armored concrete resting on beams and buttresses; central basin has outside diameter of 216 ft 6 in., and floor is composed of segmental vaults in compressed concrete.

Reservoirs, Silt. Silting of Reservoirs. *Engineering*, vol. 144, no. 3737, Aug. 27, 1937, pp. 233–234. Editorial comment, with reference to recent research; it is concluded that if control is to become more useful, knowledge of mechanism of siltation must attain greater measure of precision than exists at present.

Testing. Torsion des hausses et chevalets des barrages a hausses, R. Peltier. *Annales des Ponts et Chaussees*, vol. 107, no. 6, June 1937, pp. 805–859. Results of structural tests of models of collapsible weirs made at Laboratoire du Batiment et des Travaux Publics, Paris; theoretical analysis of torsional stresses in decks and supports of such weirs; principles of their design.

Weirs, Discharge. Crest Lengths Classify Discharge, R. Abbett. *Eng. News-Rec.*, vol. 119, no. 15, Oct. 7, 1937, pp. 594–595. Classification of unsubmerged flow over sharp-edged rectangular weirs, according to crest length, by plotting results from experiments on 11 such weirs; plotting variation of several weir characteristics with crest length, indicating possible three-zone classification of weir flow; crest-length criterion; critical weirs.

FLOOD CONTROL

Drainage, Chicago. Chicago River Controlling Works, H. P. Ramey. *West. Soc. Engrs.—J.*, vol. 42, no. 1, Feb. 1937, pp. 2–15. History of Chicago drainage canal and developments of controlling works for Chicago River in Chicago Harbor, near mouth of river, constructed as part of general program of sewage treatment; works estimated to cost over $58,000,000; effect of use of control works.

Fitchburg, Mass. No More Floods for Fitchburg. *Eng. News-Rec.*, vol. 119, no. 15, Oct. 7, 1937, pp. 589–593. Construction of $2,000,000 channel improvement, which will provide adequate floodway on 5-mile reach of river; details of design; handling pre-cast units for concrete crib walls.

United States. Flood on Republican and Kansas Rivers, May and June 1935, R. Follansbee and J. B. Spiegel. *U. S. Geol. Survey Water-Supply Paper 796-B*, 1937, 52 pp., 6 supp. sheets. 15 cents. Detailed study of catastrophic record flood due to heavy storm of cloudburst intensity in eastern Colorado and western Nebraska during night of May 30–31, 1935, which followed two periods of general rainfall over Republican-Kansas River Basin earlier in month; rainfall and runoff records; description of damage.

FOUNDATIONS

Bridge Piers. Unusual Foundation Plant for Long Bridge. *Eng. News-Rec.*, vol. 119, no. 11, Sept. 9, 1937, pp. 421–424. Construction of pier foundations for highway bridge over Neches River, near Port Arthur, Tex., 7,700 ft long; includes eight pairs of circular caissons, 18 to 32 ft in diameter, sunk about 100 ft through muck and sand, and low concrete piers supported by total of 1,600 untreated wood piles; construction equipment and procedure featuring ingenious pile-driver, dredged canal for construction access, and deep sand islands for small piers.

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